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FINAL BASEWIDE REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN KANSAS  
CITY MO  
10/1/1999  
CH2M HILL

FINAL

# *Richards-Gebaur Air Force Base Basewide Remedial Investigation / Feasibility Study (RI/FS) Work Plan*

*Prepared for  
Air Force Center for  
Environmental Excellence  
San Antonio, Texas*

October 1999

***Draft Responses to MDNR Comments***  
***Richards-Gebaur Basewide RI/FS Work Plan***

<b>Comment #</b>	<b>Air Force Response</b>
1	The Final Work Plan will be reviewed and stamped by a state-registered geologist from CH2M HILL's St. Louis office.
2	It is important to recognize that the Richards-Gebaur RI/FS Work Plan is in fact a supplement to the many previous characterizations, studies, and removal actions that have occurred over the past 15 years. These investigations were evaluated and consolidated into the ECS to provide a baseline of data for the current Work Plan. The scope of the Work Plan was agreed upon at previous BCT meetings and was specifically designed to fill the data gaps identified in the ECS. The BCT concurred that the proposed field efforts were generally sufficient, recognizing that modifications would be made as necessary during the Work Plan review period. Based on the review comments, modifications to the Work Plan scope will be made as described below, with appropriate concurrence of the BCT
3	The Air Force acknowledges that CERCLA regulations apply and that ARARs must be used to establish site-specific cleanup goals. In the absence of ARARs, the BCT has agreed to use the State of Missouri CALM Guidance process and associated cleanup target values for soil and groundwater
4	The Dames & Moore work is being conducted and reported separately from the Basewide RI/FS
5	Of the 23 sites evaluated in the ECS, only 16 are addressed in the Basewide RI/FS. This is because three sites have received NFRAP status, and the remaining four sites – AOC 006, AOC 12, AOC 12A, and CS 003 – have been assigned to Dames & Moore.
6	See response to comment # 5
7	See response to comment # 5
8	See response to comment # 5
9	See response to comment # 5
10	See response to comment # 5
11	As agreed to by the BCT, in the absence of ARARs, the TBC CALM Guidance will be used to help determine action levels for the RI/FS
12	Groundwater elevations will be monitored monthly for a minimum of

	one year.
13	The Air Force concurs.
14	MNA parameters are being assessed at the four sites that, based upon the historical sampling data, are judged to have the highest potential for organic chemicals in groundwater. This approach was approved by the BCT.
15	Fate and transport modeling will be conducted as necessary, based upon the results of the RI. If concentrations of COCs are below BCT-agreed cleanup levels, then modeling would not be considered necessary.
16	In instances where RI data show concentrations of COCs above applicable cleanup levels, the site will be further evaluated during the FS in accordance with the CERCLA process and the nine criteria established in Section 300.430 of the NCP.
17	See response to comment # 3
18	The BCT agreed to use the 1999 ECS as the baseline for the Basewide RI/FS. The ECS contains site-specific summaries of the full scope of environmental investigations that have taken place over the past 20 years; it is intended to be the one reference document that consolidates basewide environmental data, identifies data gaps, and forms the foundation for future work, specifically the RI/FS. The RI report will focus upon the results of the RI sampling and analysis. It will evaluate these results against the existing data to assess whether a site requires inclusion in the FS, requires further investigation, or is eligible for consideration as a potential NFRAP site, pending BCT approval.
19	The Air Force will modify Section 2.2.6 accordingly.
20	The Air Force will provide the referenced documentation.
21	Tables 2-1 and 2-2 are summary tables that list COCs only. The Air Force will analyze RI samples for the list of parameters routinely included in each of the EPA Analytical Methods referenced in these tables, and also listed in Section 6, Table 6-1, of the SAP.
22	Section 2.7 will be expanded to provide more detail. The proposed location of background wells is shown on Figure 2.2. The final location of the wells is subject to BCT approval. As with the other RI wells, the background wells will be installed about 6 – 12 inches into bedrock to monitor across the bedrock/overburden interface. Regarding analytical parameters, soil and groundwater samples will only be tested for naturally occurring metals. Soil samples will be collected from the monitoring well borings at nominal depths of 1 foot and 5 feet below ground surface.

23	See response to comment # 22
24	See response to comment # 22
25	See response to comment # 22
26	The monitoring wells are designed with 10-foot long screens, sufficient to monitor the expected range of groundwater level fluctuations and also to intercept potential LNAPL.
27	The Air Force concurs The text will be amended accordingly.
28	The Air Force concurs The text will be amended accordingly.
29	The Air Force will not drill the referenced casing vent holes The text will be amended accordingly.
30	The list of parameters is not meant to be complete; it is meant to be illustrative. The text will be amended to remove the parenthetical examples
31	The soil cores will be split before screening is initiated Sections of soil that appear to be contaminated will be isolated, placed in ziplock bags or sample jars, transferred to a warm environment, and screened again with the PID after a minimum elapsed time of 1 hour. The results will be recorded in the field log book Samples registering the highest PID readings will be sent for offsite laboratory analysis.
32	Aqueous samples for metals analysis will be filtered and unfiltered to allow comparison and evaluation of the relative contributions of metals adsorbed to sediment particles versus dissolved metals.
33	GPS will be used to help locate sediment and surface water sampling locations Section 4.6 of the SAP will be amended accordingly.
34	The goal of the air monitoring is to protect worker health and safety; it is not meant to be a quantitative assessment of airborne chemicals
35	The sample depth will be measured using a tape measure, using the ground surface as the reference datum. The depth will be recorded on the sample label, the boring log, and the field log book
36	Based on the existing site data, there is no evidence to justify TPH constituents and SVOCs as COCs at AOC 001
37	The purpose of the Phase 1 sampling is to confirm the presence of COCs in sediments and surface water. Based upon the available data, there is no evidence to suggest the existence of contaminant plumes. Should COCs be detected above applicable cleanup levels, then Phase 2 work will be triggered, and potential impacts to groundwater quality at the site evaluated.
38	Basewide background concentrations for metals in soil, sediment, surface water, and groundwater will be established as described in the

	amended Section 2.7 (please refer to response to comment # 22). At AOC 001, site-specific background samples will be collected from the north drainage channel because this area has not been subject to runoff from the flightline. The text will be amended accordingly
39	The Air Force concurs
40	The purpose of Phase 2 is to evaluate potential impacts of contaminated sediment or surface water on underlying groundwater. See also response to comment #37.
41	See response to comment #37.
42	The Air Force Concur's Seep sampling is described in Section 1 3 1.4
43	The Phased approach to work at AOC 001 (and AOC 002) was agreed to by the BCT following agency review of the draft Site Sampling Plans. If surface water or sediment is found to contain levels of COCs above applicable cleanup targets, then Phase 2 will be initiated.
44	Section 2 3 is incorrect. background levels for organic compounds do not exist The text will be amended accordingly.
45	The objective of the Phase 1 sampling is to confirm the presence of COCs at the Drainage Pond. Should concentrations of COCs exceed applicable cleanup targets, then Phase 2 will be initiated
46	The Drainage Pond walls are bedrock and will not be sampled. However, sediment samples will be collected at the bypass outfall and the French drain outfall (see response to comment # 52 below). The OWS corresponds to CS 003, a site being separately addressed by Dames & Moore because it is outside of the scope of the RI/FS
47	The previous samples indicated relatively low levels of longer-chain petroleum hydrocarbons and PAHs. No other organic or inorganic compounds were detected. The purpose of Phase 1 is to confirm that TPH and PAH constituents are still present at the site and, if so, at what concentrations. If necessary, Phase 2 will be initiated, as stated in the response to comment #45 above
48	VOCs and metals were originally considered COCs at the site However, based on the earlier sampling results, they should no longer be considered COCs. The text will be amended accordingly, and TPH and PAH constituents designated as the COCs
49	See response to comment # 45.
50	See response to comment # 45 and comment # 47
51	The BCT considered sampling soils below the pond liner, but deferred a decision pending the results of the RI. Concern exists that piercing

	the liner would create a potential migration pathway to groundwater.
52	The Air Force concurs. The text will be amended accordingly to add sediment samples at the bypass outfall and the French drain outfall.
53	The Air Force does not know of any other chemicals that could have been released from spent brass bullet casings.
54	The comment cannot be addressed at this time.
55	The Air Force disagrees. The Firing Range site has been previously characterized. Thirty-three soil samples and six pairs of surface water/sediment samples have been collected. Based on these data, the COCs have been identified as copper, lead, and zinc. This information has been presented in the ECS Report and has been reviewed and accepted by the BCT.
56	The 8-inch vitrified clay storm sewer was located above the fuel hydrant line. It was encountered at the east end of the soil excavation and soil samples collected upgradient and downgradient of the damaged fuel line – samples were non-detect for hydrocarbons.
57	The boring locations were modified based on recent feedback from the BCT. The text will be amended to reflect the new proposed locations.
58	The Air Force concurs.
59	MW-2 has been located and the cover freed for well access. The Air Force does not intend to use the well to monitor water quality because its integrity has been compromised by the asphalt paving. The well will be used as a groundwater elevation point to aid in understanding the site and basewide hydrogeology.
60	The Air Force concurs.
61	The Air Force does not support this hypothesis.
62	Wells GMW 604/605/606/607 were drilled to top of bedrock, approximately 33 feet below ground surface.
63	The Air Force concurs. The text will be amended to state that should field screening and observations indicate soil contamination, then one additional monitoring well will be installed within the fire pit to investigate potential impacts to groundwater quality.
64	The oil saturated area and the waste oil storage area are the same.
65	The Air Force disagrees. Based on previous sampling results, VOCs and SVOCs were not present in soils at concentrations exceeding applicable action levels, and therefore were eliminated from being COCs. This conclusion was stated in the ECS report and has been accepted by the BCT.

66	There are no records to support the contention that spent solvents and degreasers were stored at SS 006. The area was used to store virgin chemical products only. The Air Force was classified as a small-quantity generator in accordance with RCRA and had 21 designated satellite accumulation points for waste chemicals. One of these was Building 927, which is located opposite Site SS 006.
67	The Air Force concurs. One additional soil boring will be drilled to bedrock at the location of the former soil removal. Three soil samples will be collected: one immediately below ground surface; one between four and five feet below grade, and one immediately above bedrock. The soil samples will be analyzed for TPH constituents, VOCs, SVOCs, and metals. The text will be amended accordingly.
68	The purpose of the proposed work is to confirm the presence of previously detected organic chemicals in groundwater, especially considering the absence of VOCs in overlying soils. At present, there is no evidence to support the assertion of a contaminant plume.
69	It is likely that the refusal of a direct-push sampler at four feet below grade did not accurately indicate the true depth to bedrock. Or, the well that went to 16 feet below grade was located at the intersection of two or more joint planes. The actual depth to bedrock will be determined in the RI during the drilling of the soil boring and three monitoring wells. Every effort will be made during the RI to monitor those zones or intervals where previous chemical detections occurred.
70	The site has been adequately characterized: 61 soil samples have been collected. Of these, one was found to contain 240 ppm of TPH constituents and low concentrations of PAHs. The additional soil sampling will evaluate whether the previous detection was truly representative of subsurface conditions, or simply an artifact of sampling. The weight of evidence (60 clean soil samples) suggests the latter explanation. The goal of the monitoring well is to assess the occurrence and quality of groundwater (eight dry borings are on record) and, if present, evaluate groundwater quality.
71	VOCs were not detected in any of 61 samples, nor was it detected in the one grab water sample. There is no evidence that VOCs are present on the site, therefore VOCs are not justifiable COCs at SS 008.
72	The Air Force concurs. See also response to comment # 70.
73	The Air Force has researched the historical land use in the vicinity of SS 009 and has found no indications of potential sources for the organic chemicals found in groundwater samples from the site.
74	The water line has been investigated. 70 soil samples from 21 soil borings were collected during a 1995 investigation. One sample of the seventeen contained TPH constituents above 50 ppm – at 370



	ppm
75	The Air Force disagrees. SVOCs have been analyzed in previous investigations and have not been found to occur above applicable cleanup target levels. Based on the data, SVOCs are no longer COCs at the site.
76	The text will be amended to include the referenced Table 6-26.
77	The BCT has agreed that the extent of soil sampling already completed (over 400 samples) at the POL Yard is sufficient to define the extent of soil contamination. The proposed investigation focuses on an unconfirmed soil sample result (TPH = 1,710 ppm) from a depth of 15 feet at MW-3D and also investigates current groundwater quality. At present, there is no data to support the notion of a groundwater plume.
78	The well that is slated for replacement is MW-1208. It will likely be replaced 50-100 feet to the north of its present location. Figure A.43 will be revised to illustrate the new location of MW-1208R.
79	The piping runs at ST 007 fall within the purview of Site AOC 006, the Tarmac Fuel Area. This site is being addressed by Dames & Moore and is not part of the Basewide RI/FS.
80	The six proposed soil borings at Site ST 007 are intended to go to bedrock, as stated in Section 15.3 1.3 of the SAP. However, these borings are located at the periphery of the former UST. To address concerns that previous soil sample depths in the center of the site were too shallow, the Air Force proposes to drill and sample two additional borings to bedrock in the center of the former UST area. The corresponding text and figures will be amended accordingly.
81	The Air Force disagrees. The proposed locations are deliberately biased to the areas of the site that have been shown through sampling to be most contaminated. The locations have been reviewed by the BCT and accepted.
82	The generator building was investigated previously and no evidence of chemical storage, handling, or use was found to warrant designation as an AOC.
83	The hazardous materials storage shed was investigated previously and no evidence of chemical storage, handling, or use was found to warrant designation as an AOC.
84	General waste includes non-hazardous solid wastes such as paper, plastic, wood, metal, brick, and concrete.
85	The property is owned by the US Marines, and its intended future use is as a training ground. There are no known plans to use the acreage for agriculture.

86	The scope of the RI investigation at XO 001 is designed to address the areas of concern that have been identified by past investigations. The scope of work has been developed in consultation with the BCT, reviewed by the BCT, and accepted as reasonable. Areas that have been previously investigated and found to be uncontaminated are excluded from the scope of the proposed investigation. Similarly, sites that have been previously assessed and judged to be unworthy of an AOC designation will not be further investigated during the RI.
87	The USAF has no plans at present to further address unexploded ordnance issues at the Belton Training Complex.
88	During previous investigations VOCs, SVOCs, and explosives were not detected in any soil, surface water, or groundwater at the site. Therefore, there is no justification to support their inclusion as COCs at Site XO 001.
89	The Air Force concurs.
90	The Air Force does not understand the question.
91	The Air Force concurs.

**Dames & Moore Responses To:  
Missouri Department of Natural Resources Comments On  
Work Plan and Field Sampling Plan**

**REMEDIAL ACTIONS/INVESTIGATIONS AT MULTIPLE SITES  
FORMER RICHARDS-GEBAUR AIR FORCE BASE, MO**

Item	Sect.	Page	Comments
<b>GENERAL COMMENTS</b>			
1. & 2.			<p>Comment: The document named above does not bear the seal of a geologist who is registered in the State of Missouri. The document incorporates or is based on a geologic study or on geologic data that had a bearing on conclusions or recommendations reached after January 1, 1997. The Missouri Board of Geologist Registration is charged with the enforcement of the Missouri Geologist Registration Law that includes the requirement that geologic work where public health, safety or welfare are at risk or potentially at risk be completed by or under the direct supervision of a geologist registered in Missouri. The following review comments and/or recommendations convey no endorsement as to the validity of the work being completed in accordance with the Missouri Geologist Registration Law or the Board of Geologist Registration. Further, the review comments and/or recommendations cannot be accepted as being fully completed until the reviewed document is properly sealed/stamped by a geologist registered in Missouri in accordance with the law and the rules as administered by the Board.</p> <p><b>Response: The RA Work Plan and Field Sampling Plans will be sealed/stamped by Laurence K. Moore (Missouri Registered Geologist #0469) in accordance with the law and the rules as administered by the Board.</b></p>
3.			<p>Comment: The Underground Storage Tank Closure Guidance Document (Closure Guidance Document) is the applicable or relevant and appropriate requirement for closing the hydrant lines, industrial waste line, oil water separators and all underground storage tank systems. The Closure Guidance Document should be used to determine the appropriate sampling locations, required analyses and cleanup levels for soil and groundwater at these locations. The CALM Document may be referenced for soil and groundwater cleanup levels for compounds not listed in the Closure Guidance Document. The cleanup levels should be established and approved by the department prior to work beginning, however, the cleanup levels could be modified as additional site information is acquired.</p>

Item	Sect.	Page	Comments
			<p><b>Response:</b> Reference will made to the MDNR UST Closure Guidance Document as the applicable or relevant and appropriate requirement (ARAR) for the closing the fuel hydrant line, industrial waste line, oil/water separators, and all UST locations. The CALM Document will be considered for soil and groundwater cleanup levels for compounds not listed in the Closure Guidance Document. Dames &amp; Moore has generated a LUST Soil Cleanup Matrix (Table 4 in the MDNR UST Closure Guidance Document) for each site that will require a UST Closure Report. These matrices are attached with the response to comments and will be included in the appendix of the Work Plan and Field Sampling Plan.</p>
4.			<p>A site characterization is required when groundwater contains contaminants above the analytical detection limit per the Closure Guidance Document.</p> <p><b>Response:</b> A site characterization will be performed at sites where groundwater contaminants have been reported above the analytical detection limit as referenced in the UST Closure Guidance Document. A geoprobe unit will be utilized to collect ground water samples for on-site screening and for off-site laboratory analysis to delineate the extent of groundwater impact (if any). Groundwater samples will be collected according to the MDNR UST Closure Guidance Document.</p>
5.			<p>Why are excavations being backfilled before confirmation data is received? If the excavations are backfilled before they are confirmed to have met the remedial goals they should be lined with plastic prior to backfilling.</p> <p><b>Response:</b> Due to safety issues and budgetary constraints, the excavations will be backfilled prior to the receipt of confirmatory sample results. Dames &amp; Moore will line the excavations with plastic prior to backfilling to delineate the boundaries of the previous excavation should re-entry be necessary.</p>
6.			<p>Some method of recording the locations of excavations and samplings must be implemented so these locations can be relocated if necessary.</p> <p><b>Response:</b> The locations of the excavations and sampling points will measured from existing buildings or other permanent fixtures within the area of the site. A hand held GPS receiver will be used to mark the center of the excavation (accuracy of 5 to 10 meters). A three foot long steel rod will be driven into the soil to mark the center of the former excavation.</p>

Item	Sect.	Page	Comments															
7.			<p>Documentation of proper disposal of the underground storage tank (UST) and sludge will be necessary to close the UST sites. Given that most of the USTs at the base were removed over a decade ago a search for this documentation should be initiated.</p> <p><b>Response:</b> Dames &amp; Moore will follow the MDNR UST Closure Guidance Document requirements to submit an accurate UST Closure Report containing as much information as possible for each of the UST sites. However, it should be noted that most of these tanks were removed prior to December 22, 1988 and were not subject to the MDNR UST Closure Guidance Document. No additional searches will be performed.</p> <p>Final Comment: An explanation such as this must be included with each report.</p> <p><b>Final Response:</b> Based on the information in the March 5, 1999 WPI Report, <u>Evaluation of Underground Storage Tanks at Richards-Gehaur AFB</u>, documentation of the tanks and tank sludge does not exist and will be stated so in the Closure Reports.</p>															
WORK PLAN SPECIFIC COMMENTS																		
8.			<p>Comment: Work Plan</p> <p><b>Response:</b> No Response Necessary.</p>															
9.	1.2.2	1-3	<p>Building 1100 Comment: Section 1.2.2: How deep were the soil borings advanced during the 1998 investigation? Significant levels of contamination were detected in several of the soil borings; however, neither the sampling depths nor the depths of contamination are presented.</p> <p><b>Response:</b> Six soil borings, SB1 through SB6 were advanced at 4-foot intervals to a depth of approximately 10 to 11 feet below ground surface (bgs) where refusal on limestone bedrock occurred.</p> <table><tr><th>Sample</th><th>Boring Depth (ft.)</th><th>Sample Depth</th></tr><tr><td>SB1</td><td>10.8</td><td>6.5 to 7.0</td></tr><tr><td>SB2</td><td>10.1</td><td>1.9 to 4.0</td></tr><tr><td>SB3</td><td>10.3</td><td>1.9 to 4.0</td></tr><tr><td>SB4</td><td>10.9</td><td>4.0 to 5.0</td></tr></table>	Sample	Boring Depth (ft.)	Sample Depth	SB1	10.8	6.5 to 7.0	SB2	10.1	1.9 to 4.0	SB3	10.3	1.9 to 4.0	SB4	10.9	4.0 to 5.0
Sample	Boring Depth (ft.)	Sample Depth																
SB1	10.8	6.5 to 7.0																
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SB3	10.3	1.9 to 4.0																
SB4	10.9	4.0 to 5.0																

Item	Sect.	Page	Comments
			<p>SB5 10.5 8.0 to 9.0</p> <p>SB6 10.2 3.0 to 4.0</p> <p>The above information will be added to the Work Plan.</p>
10.	1.2.2	1-3	<p>Building 1100 Comment: Section 1.2.2: At what depth were contaminants detected in boring SB-6?</p> <p><b>Response: Contaminants were found at a depth of 3.0 to 4.0 feet bgs. The above information will be added to the Work Plan.</b></p>
11.	1.2.2	1-3	<p>Building 1100 Comment: Section 1.2.2: Where were the piping runs and vent lines for the two underground storage tanks (USTs)?</p> <p><b>Response: No information was found regarding the location of the piping runs and vent lines for the two (2) USTs at Building 1100.</b></p> <p>Final Comment: All piping not located immediately above the UST excavation must be sampled per the closure guide.</p> <p><b>Final Response: An effort will be made to locate heretofore unseen as-built drawings of Building 1100 to find the previous location of piping and vent lines. Should the drawings not be available, effort will be made during the field work to estimate the previous location of the lines in relation to remaining appurtenances (e.g. the boiler, wall fittings for vent pipes, hole in building for piping, etc.) in order to collect samples per the Closure Document.</b></p>
12.	1.2.2	1-3	<p>Building 1100 Comment: Section 1.2.2: All of the compounds detected in the groundwater sample from boring SB-1 exceed the CALM Tier 1 GTARC values.</p> <p><b>Response: See Response to General Comment 4.</b></p>
13.	1.2.3	1-4	<p>Building 1200 Area Comment: Section 1.2.3: Why was a groundwater sample not collected from the investigation at Building 1202?</p> <p><b>Response: This information is not available but it is likely that groundwater was not encountered during the previous site investigation.</b></p>
14	1.2.4	1-5	<p>Site ST007 Comment: Section 1.2.4: The Environmental Consolidation Study (ECS) (January 1999) indicated that arsenic had been detected above the CALM Tier 1 STARC value in a sample from the 1991 investigation.</p>

Item	Sect.	Page	Comments
			<p><b>Response:</b> Since the USTs at Site ST007 were used solely to contain aircraft fuel while in service, the arsenic concentration is likely a background issue and not related to the historical useage of the site.</p> <p>Final Comment: The USAF has no documentation to support this statement at this time. You may simply state the level is above the cleanup objective and will be evaluated after background metal levels have been established.</p> <p><b>Final Response:</b> The presence of arsenic at this location will be evaluated in the RI being conducted by CH2MHill, once background wells have been sampled and analyzed. However, the detection of arsenic in a 1991 groundwater sample is irrelevant to the scope of work (removal of 18 bio-vent casings) of the Dames &amp; Moore Work Plan and Field Sampling Plan.</p>
15.	1.2.4	1-4	<p>Site ST007 Comment: Section 1.2.4: It is unclear why Site ST007 is addressed in both the August 1999 Remedial Investigation/Feasibility Study and the current Remedial Actions/Investigations Work Plan.</p> <p><b>Response:</b> The Dames &amp; Moore and CH2MHill work is being performed under separate contracts based on different types of work. The removal of the bio-vent casings is not related to the RI/FS work being performed by CH2Mhill.</p>
16.	3.6.2	3-7	<p>Fuel Hydrant Line Comment: Section 1.2.5: When and who will investigate the piping run to Building 902 and any other piping?</p> <p><b>Response:</b> Dames &amp; Moore will investigate the piping run to Building 902. The piping run in question is included in the 5,800 feet of the Fuel Hydrant Line project.</p>
17.	1.2.6	1-6	<p>Industrial Waste Line Comment: Section 1.2.6: How was it determined that there is no history of soil or groundwater contamination associated with this site? There have been no previous characterization efforts conducted at the site</p> <p><b>Response:</b> No investigations have been performed along the industrial waste line, therefore no history of contamination exists involving the line.</p>
18.	1.2.6	1-6	<p>Industrial Waste Line Comment: Section 1.2.6: The source of the flow in the line must be determined and all inlets identified and plugged before the manholes are destroyed or the oil water separators removed.</p> <p><b>Response:</b> The inlets (source) to the industrial waste line were identified through a review of as-built drawings followed by a site walk-through of</p>

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			<p>associated buildings by Dames &amp; Moore personnel. The industrial waste line inlets will be plugged with at least five feet of grout and capped with concrete prior to the collapse of the manholes along the length of the line. If flow remains in the line once the inlets have been plugged, the flow will be considered infiltration water. Dames &amp; Moore will not attempt to determine the source of the infiltration water. The oil/water separator will be removed only after the completion of all other projects in this delivery order.</p> <p><b>This text will be added to the Work Plan.</b></p>
19.	1.2.8	1-7	<p>Building 942 Comment: Section 1.2.8: The groundwater contamination at Building 942 must be characterized.</p> <p><b>Response: See Response to General Comment 4.</b></p>
20	1.2.8	1-8	<p>Building 944 Comment: Section 1.2.8: The discrepancy between the UST sizes shown on the as-built drawings for Building 944 and the size of the USTs removed needs to be resolved/explained. Were one or two sets of USTs installed? If two sets were used, where were all four USTs installed and where were the piping runs?</p> <p><b>Response: The information presented in the Waste Policy Institute, March 5, 1999, "Evaluation of Underground Storage Tanks at Richards-Gebaur AFB", report will be used as the definitive data source for this site.</b></p>
21.	1.2.8	1-9	<p>Building 1025C Comment: Section 1.2.8: Did UST 1025C go into the same excavation as 1025A or a different location?</p> <p><b>Response: UST 1025C did go into the same excavation as UST 1025A.</b></p>
22.	1.2.9	1-9	<p>Site ST005 Comment: Section 1.2.9: It is unclear why Site ST005 is addressed in both the August 1999 Remedial Investigation/Feasibility Study and the current Remedial Actions/Investigations Work Plan</p> <p><b>Response: See Response To Comment 15.</b></p>
23	1.3	1-11	<p>Building 1100 Area Comment: Section 1.3, 1100 Area: Groundwater sampling in 1998 demonstrated that ethylbenzene, naphthalene, m&amp;p xylene, and vinyl chloride were present above current CALM Tier 1 GTARC values. Efforts must be made to further characterize site hydrogeology and determine the horizontal and vertical extent of potential contaminants in groundwater at this site.</p>



Item	Sect.	Page	Comments
			<b>Response: See Response to General Comment 4.</b>
24.	1.3	1-11	<p>Building 1200 Area Comment: Section 1.3, 1200 Area: One sample collected at Building 1202 is not sufficient to close the site, please refer to the Closure Guidance Document.</p> <p><b>Response: Two samples were collected at Site 1202, B1 and B2. The samples were analyzed for TPH, VOCs and SVOCs. None of the analytes were detected at 13 to 15 feet in the B1 boring. Several VOCs, SVOCs and TPH were detected at 8 to 10 feet in B2, all well below the MDNR CALM Tier 1, Category B target concentrations. The USTs at 1202 were used to store heating oil for consumptive heat, therefore, were exempt from the MDNR UST closure requirements (March 1996 MDNR UST Closure Guidance Document, Section 2.2, Closure Requirements for Heating Oil USTs (page 2-2). A Closure Report will be written for the two tanks that includes the result of the two soil samples collected.</b></p> <p>Final Comment: The most appropriate TBC for the heating oil tanks is the closure guide not the CALM document. All reports submitted for heating oil tanks must comply with the closure guide requirements.</p> <p><b>Final Response: Response to Comment #3 states that the MDNR UST Closure Guidance Document is the ARAR. An effort will be made to locate heretofore unseen as-built drawings of the Building 1200 Area to find the previous location of piping and vent lines. Should the drawings not be available, effort will be made during the field work to estimate the previous location of the lines in relation to remaining appurtenances (e.g. the boiler, wall fittings for vent pipes, hole in building for piping, etc.) in order to collect samples per the Closure Document.. Additional samples will be collected if necessary in an effort to close this site.</b></p>
25.	1.3	1-12	<p>Fuel Hydrant Line Comment: Section 1.3, Fuel Hydrant Line: How will the line be filled with grout?</p> <p><b>Response: The flowable grout material will be pressure pumped into the line until flow is established at the effluent end, then capped.</b></p>
26.	1.3	1-12	<p>Industrial Waste Line Comment: Section 1.3, Industrial Waste Line: How much of the drain line in each building and other inlets will be filled with grout?</p> <p><b>Response: The following sentence will be added to the paragraph concerning the industrial waste line on page 1-12: The industrial waste</b></p>

Item	Sect.	Page	Comments
			line inlets will be plugged with at least five feet of grout and capped with cement (flush with the floor).
27.	1.3	1-12	<p>Site ST007 Comment: Section 1.3, Site ST007: Soil sampling at this site has indicated TPH concentrations above CALM Tier 1 STARC values. Other than removal of the bio-vent wells, no further investigation activities are planned for this site. Please explain.</p> <p><b>Response: Site ST007 is being investigated by CH2MHill as part of their RI/FS.</b></p>
28.	3.2 FSP	3-8 FSP	<p>Fuel Hydrant Line Comment. Section 1.3, Fuel Hydrant Line. The Field Sampling Plan does not include analysis of soil samples for BTEX. The ECS identified additional work that needed to be done to proceed toward site closure. This work included analysis of soils for BTEX constituents. Please explain.</p> <p><b>Response: On page 3-8 of the Field Sampling Plan, Table 3.2-4 states that 58 confirmatory soil samples will be collected and analyzed for volatile organic compounds (VOCs) by Method 8260, which includes benzene, toluene, ethylbenzene, and xylene.</b></p>
29.	1.3	1-12	<p>Industrial Waste Line Comment: Section 1.3, Industrial Waste Line: The ECS identified additional work that needed to be done to proceed toward site closure. This work included collection of soil samples every 400 feet along the length of the waste line. The Field Sampling Plan in the Remedial Actions/Investigations Work Plan calls for sampling at each manhole only. Please explain.</p> <p><b>Response: Contamination (if any) would more likely be found in association with the manholes. Since the distance between each of the manholes along the industrial waste line is approximately 400 feet, sampling at the manhole locations seemed prudent and cost effective.</b></p> <p>Final Response: The IWL is constructed of vitrified clay pipe and is as likely to leak at any joint as it is at a manhole. The sampling at every manhole is acceptable.</p> <p><b>Final Response: Comment noted.</b></p>
30.	1.3	1-13	OWS 9470 Comment: Section 1.3, Oil/Water Separators: The document indicates that the closure activities at this site include the removal of the oil/water separators. Post-excavation soil sampling beneath the former

Item	Sect.	Page	Comments
			<p>separators should be considered.</p> <p><b>Response:</b> The second sentence of the third paragraph under Oil/Water Separators on page 1-13 now reads: "Additional confirmation soil samples from the excavation floor and samples of any ground water entering the excavation will be obtained and analyzed for the parameters presented in Section 3.2 of the FSP."</p>
31	1.3	1-13	<p>OWS 9470 Comment: Section 1.3, Oil/Water Separators: It is reported that there is no history of soil or groundwater contamination associated with this site. How was it then determined that up to 100 cubic yards of contaminated soil exist at this site?</p> <p><b>Response:</b> There is no history of soil or groundwater contamination at this site. For contractual and budgetary purposes, Dames &amp; Moore estimated that up to 100 cubic yards of contaminated soil could be associated with this tank. The volume (100 cubic yards) was based on the size of the tank and on previous experience with USTs. Should contamination be found at this site, the mechanism is in place for the remediation of up to 100 cubic yards of soil without work stoppage.</p>
32.	1.3	1-13	<p>OWS 9470 Comment: Section 1.3, Oil/Water Separators: Why are direct push samples being collected if confirmation samples will be collected following removal and over-excavation?</p> <p><b>Response:</b> Due to the precarious location of OWS 9470 (low overhead power lines, sloped ground surface, adjacent to a creek and wooded area) collecting soil samples prior to excavation is a logistical solution to a potential problem. Once the removal activities have commenced, the movement of the track excavator is likely to be restricted.</p>
33.	2.1.8	2-3	<p>Work Plan Comment: Section 2.1.8, Base Hydrogeology and Ground Water Use: The potability of the ground water at the base has yet to be determined. Numerous wells exist within one mile of the base</p> <p><b>Response:</b> A water well search conducted by CH2MHill within a one mile radius of Richards-Gebaur AFB located no potable drinking water wells in service.</p> <p>Final Comment: The MDNR will accept this response for the UST work, however, this issue will be revisited and further documentation will be required</p>

Item	Sect.	Page	Comments
			<b>Final Response: Comment noted.</b>
34.	3.1	3-1	<p>Work Plan Comment: Section 3.1, Table 3.1-1: The table lists TPH in soil as the primary contaminant of concern. All of the compounds detected in groundwater sample SB-1 at the 1100 area exceeded the CALM Tier 1 GTARC values. These compounds should be considered as contaminants of concern in groundwater and further investigation should be conducted.</p> <p><b>Response: See Response to General Comment 4.</b></p>
35.	3.1	3-1	<p>Work Plan Comment: Section 3.1, Table 3.1-1: The table lists TPH in soil as the primary contaminant of concern. However, the ECS identified BTEX analysis of soils as necessary to proceed toward site closure. In addition, Table 3.2-4 of the Field Sampling Plan lists TPH, VOCs and SVOCs as soil sample analytes. Please explain why BTEX, VOCs, and SVOCs are not listed as primary contaminants of concern.</p> <p><b>Response: In Table 3.1-1 of the Work Plan, the primary contaminants of concern for the Fuel Hydrant Line Closure are now listed as VOCs (including BTEX), SVOCs, and TPH.</b></p>
36.	3.1	3-1	<p>Work Plan Comment: Section 3.1, Table 3.1-1: The table lists VOCs and SVOCs in soil as the primary contaminants of concern. In addition to VOCs and SVOCs, Table 3.2-5 of the Field Sampling Plan also lists TPH as a soil sample analyte.</p> <p><b>Response: In Table 3.1-1 of the Work Plan, the primary contaminants of concern for the Industrial Waste Line Closure are now listed as VOCs, SVOCs, and TPH.</b></p>
37	3.1	3-1	<p>Work Plan Comment: Section 3.1, Table 3.1-1: The table lists TPH in soil as the primary contaminant of concern. However, Table 3.2-11 of the Field Sampling Plan also lists BTEX as a soil sampling analyte.</p> <p><b>Response: In Table 3.1-1 of the Work Plan, the primary contaminants of concern for the Building 903 Closure are now listed as BTEX/MTBE and TPH.</b></p>
38.	3.2	3-2	<p>Work Plan Comment: Section 3.2, Applicable or Relevant &amp; Appropriate Requirements: The Closure Guidance Document is the primary regulatory guidance for the work plan not the CALM document.</p> <p><b>Response: See Response To Comment 3.</b></p>

Item	Sect.	Page	Comments
39	3.6.2	3-5	<p>Building 1100 Area Comment: Section 3.6.2, Area 1100: Although field activities include the sampling of any groundwater that enters the excavation, further investigative activities are not planned. Previous sampling revealed contaminants in groundwater above CALM Tier 1 GTARC values. Efforts must be made to further characterize site hydrogeology and determine the horizontal and vertical extent of contaminants in groundwater. Groundwater sampling should not be limited to that water which infiltrates the excavation.</p> <p><b>Response</b> See Response to General Comment 4.</p>
40.	3.6.2	3-6	<p>Building 1200 Area Comment. Section 3.6.2, Building 1201: Although field activities include the sampling of any groundwater that enters the excavation, further investigative activities are not planned. Previous sampling has revealed contaminants in groundwater at this site. Efforts must be made to further characterize site hydrogeology and determine the extent of contaminants in groundwater<sup>1</sup>. Insufficient data exists to generate a closure report for Building 1202<sup>2</sup>.</p> <p><b>Response<sup>1</sup>.</b> See Response to General Comment 4.</p> <p><b>Response<sup>2</sup>.</b> See Response to Comment #24.</p> <p>Final Comment: See response [Final Comment] to Item 24.</p> <p><b>Final Response:</b> See Final Response to Item #24.</p>
41.	3.6.2	3-7	<p>Fuel Hydrant Line Comment: Section 3.6.2, Fuel Hydrant Line Closure: How will the line be cleaned and grouted?</p> <p><b>Response:</b> The Fuel Hydrant Line will be pigged clean. This method is accomplished by manually pulling an abrasive, rubber, "swab" and degreaser (citrus-based) through the line on a wire. Using the wire, the pig can be pulled in two directions to swab the line clean. The line would then be rinsed clean. The grout will be pressure-pumped into the sections of open line and capped.</p>
42.	3.6.2	3-10	<p>RI at 4/8 Former UST Sites Comment: Section 3.6.2, Remedial Investigation at Four/Eight Former UST sites: Where will the borings be installed and how where (sic) these locations identified? If as-built drawings do not show the location of the USTs the investigations must be expanded due to the uncertainty of the UST location.</p> <p><b>Response:</b> No borings will be installed at sites where investigations have already taken place. Soil excavation will initiate field activities at</p>

Item	Sect.	Page	Comments
			<p><b>Buildings 903, 942, 948, and 1025 based on the data generated from previous investigations.</b></p> <p><b>Boring locations at the 4 RI Sites were based on as-built drawings and on maps from previous investigations. These maps are located in the FSP.</b></p>
43.	3.6.2	3-11	<p>RA at 8 Former UST Sites Comment: Section 3.6.2, Eight Former UST Sites: Although field activities include the sampling of any groundwater that enters the excavation, further investigation of groundwater is not planned. Efforts should be made to further characterize site hydrogeology and to determine the presence of potential contaminants in groundwater. Sampling should not be limited to water that infiltrates the excavation.</p> <p><b>Response See Response to General Comment 4.</b></p>
<b>FIELD SAMPLING PLAN SPECIFIC COMMENTS</b>			
44.			<p>Comment: Field Sampling Plan</p> <p><b>Response: No Response Required</b></p>
45.			<p>General Field Sampling Plan Comment: The results of the Remedial Investigation should be consulted to determine if the new information collected would influence this work plan.</p> <p><b>Response: Dames &amp; Moore will monitor the results of the CH2MHill RI/FS and adjust accordingly (when possible) planning, sampling, or scheduling activities that may be affected.</b></p>
46	3.1.1	3-1	<p>Building 1100 Area Comment: Section 3.1.1, 1100 Area: The stated objectives of the field activities at this site do not include groundwater sampling. Previous sampling efforts have identified several contaminants in groundwater. One of the objectives of the field activities associated with the remedial action at this site should be further groundwater characterization.</p> <p><b>Response See Response to General Comment 4.</b></p>
47.	3.1.6	3-3	<p>OWS 9470 Comment: Section 3.1.6, Oil/Water Separators: The stated objectives of the closure activities at this site do not include contaminated soil removal. However, Section 1.3 of the Work Plan suggests that up to 100 cubic yards of contaminated soil may be present at this site. Please explain why soil removal is not one of the stated objectives.</p> <p><b>Response: In the FSP on page 3-3, the first line in Section 3.1.6 will be</b></p>

Item	Sect.	Page	Comments
			<p>changed to read, "The objective of the closure activities is to remove the components of OWS-9470A and OWS-9470B and any associated contaminated soil in accordance with the MDNR UST Closure Guidance Document."</p> <p><b>Also See Response To Comment 31.</b></p>
48.	3.1 6	3-3	<p>OWS 9470 Comment: Section 3.1.6, Oil Water Separators: Why are soil samples being collected before and after removal?</p> <p><b>Response: See Response To Comment 32.</b></p>
49.	3.1.8	3-3	<p>Building 903 Comment: Section 3.1.8, Building 903: Groundwater sampling should not be limited to water that infiltrates the excavation. Efforts should be made to further characterize site hydrogeology and to determine the presence of potential contaminants in groundwater at this site.</p> <p><b>Response: See Response to General Comment 4.</b></p>
50.	3.1.8	3-3	<p>Building 942 Comment: Section 3.1.8, Building 942: Trichloroethene was detected in groundwater sample B2 at concentrations that exceed CALM tier 1 GTARC values. Further investigation and characterization of site hydrogeology should be conducted in order to determine the presence of potential contaminants in groundwater. Sampling must not be limited to water that infiltrates the excavation.</p> <p><b>Response: See Response to General Comment 4.</b></p>
51./52.	3 1.8	3-3	<p>Building 948 Comment: Section 3.1.8, Building 948. Groundwater sampling should not be limited to water that infiltrates the excavation. Efforts should be made to further characterize site hydrogeology and to determine the presence of potential contaminants in groundwater at this site.</p> <p><b>Response: See Response to General Comment 4.</b></p>
53.	3.1.8	3-3	<p>Building 1025 Comment: Section 3.1.8, Building 1025: Groundwater sampling should not be limited to water that infiltrates the excavation. Efforts should be made to further characterize site hydrogeology and to determine the presence of potential contaminants in groundwater at this site.</p> <p><b>Response: See Response to General Comment 4.</b></p>
54.	3 2	3-19	<p>Building 948 Comment: Table 3.2-15, Building 948: TCLP metals analysis must be added for the waste oil tank.</p>

Item	Sect.	Page	Comments
			<b>Response: TCLP Metals analysis will replace the Total Metals analysis.</b>
55.	3.3.4	3-27	Hydrant Line Closure Comment: Section 3 3 4, Hydrant Line Closure: Expandable polyurethane foam is not an acceptable fill material for the line.  <b>Response: Expandable polyurethane foam has been deleted from the text.</b>

Final Comment: The approval of the matrix score for any particular site may be changed if MDNR finds conditions other than those presented in the submitted matrix.

The matrix scores for the following locations are acceptable: Bldg. 1033, Bldg. 1100 Area, Bldg. 1200 Area, Bldg. 903, Bldg. 940, Bldg. 942, Bldg. 944, Bldg. 948, Bldg. 965, Fuel Hydrant Line, Industrial Waste Line, and Bldg. 9470.

Bldg. 1025 Matrix -Only one soil permeability level may be chosen.

**Final Response: The correct score for "Soil Permeability" on the Building 1025 Matrix should be 10. The Total Score is correct and remains 145. The additional score of 5 was inadvertently left on the matrix and has been deleted.**



# TAB

Quality Program Work Plan (QPWP)

**Installation Restoration Program  
Basewide Remedial Investigation / Feasibility Study Work Plan  
for  
Richards-Gebaur Air Force Base**

**QUALITY PROGRAM WORK PLAN**

October 1999

Prepared for

**Air Force Center for Environmental Excellence (AFCEE)**  
Ms. Kay Grosinske, Contracting Officer's Representative  
IRP Program Office  
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USAF Contract No. F41624-97-D-8019  
Delivery Order 0090



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## **Attachments**

SAP Part 1 – Field Sampling Plan (FSP)

Appendix A – Site Sampling Plans (SSPs)

Appendix B – Standard Operating Procedures (SOPs)

Appendix C – Field Forms

SAP Part 2 – Quality Assurance Project Plan (QAPP)

Health and Safety Plan (HSP)

## LIST OF ACRONYMS

AB	Ambient Blank
ABAL	Area below Action Levels
ADC	Air Defense Command
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCC	Air Force Communications Command
AFCEE	Air Force Center for Environmental Excellence
AFR	Air Force Reserves
ANSC	Area of No Suspected Contamination
AOC	Area of Concern
ARAR	Applicable and Relevant or Appropriate Requirements
ASL	Any-use Soil Level
AST	Above-ground Storage Tank
AVGAS	Aviation Gasline
BCP	BRAC Cleanup Plan
BCT	BRAC Cleanup Team
BEC	BRAC Environmental Coordinator
BRA	Baseline Risk Assessment
BRAC	Base Realignment and Closure
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CAA	Clean Air Act
CALM	Cleanup Action Levels for Missouri
CAS	Columbia Analytical Services
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Chemicals of Concern
CS	Compliance Site
CSM	Conceptual Site Model

CSR	Code of State Regulations
CWA	Clean Water Act
DBCRC	Defense Base Closure and Realignment Commission
DERA	Defense Environmental Restoration Account
DGLS	Division of Geology and Land Survey
DO	Delivery Order
DoD	Department of Defense
DOT	Department of Transportation
DQO	Data Quality Objectives
DMP	Data Management Plan
DNAPL	Dense Non-aqueous Phase Liquid
DRO	Diesel Range Organics
EB	Equipment Blank
EC	Electrical Conductivity
ECS	Evaluation and Consolidation Study
EDMS	Environmental Data Management System
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERPIMS	Environmental Restoration Program Information Management System
FD	Field Duplicate
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FS	Feasibility Study
FSP	Field Sampling Plan
GIS	Geographic Information System
GRO	Gasoline Range Organics
GSA	General Services Administration
GTARC	Groundwater Target Concentrations
HAPs	Hazardous Air Pollutants
HQ	Hazard Quotient
HSP	Health and Safety Plan

IDW	Investigation-derived Wastes
IRP	Installation Restoration Program
LNAPL	Light Non-aqueous Phase Liquid
MAC	Military Airlift Command
MCLGs	Maximum Contaminant Level Goals
MCLs	Maximum Contaminant Levels
MDNR	Missouri Department of Natural Resources
MOGAS	Motor Gasoline
MSL	Mean Sea Level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MTBE	Methyl Tertiary Butyl Ether
MW	Monitoring Well
NCP	National Contingency Plan
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NFRAP	No Further Response Action Plan
NMFS	National Marine Fisheries Services
NPDES	National Pollutant Discharge Elimination System
OL	Operating Location
OSHA	Occupational Safety and Health Act
OU	Operable Unit
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbons
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
POC	Point of Contact
POL	Petroleum, Oil and Lubricant
PRG	Preliminary Remediation Goal
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QPWP	Quality Program Work Plan

RBC	Risk-Based Concentration
RCRA	Resources, Conservation and Recovery Act
RDX	Hexahydro-1,3,5- trizene
RI	Remedial Investigation
SAP	Sampling and Analysis Plans
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SI	Site Investigation
SOPs	Standard Operating Procedures
SOW	Statement of Work
SSPs	Site Sampling Plans
STARC	Soil Target Concentration
STP	Sample Tracking Program
SVOC	Semivolatile Organic Compound
SWP	Supplemental Work Plans
TAL	Target Analyte List
TB	Trip Blank
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TNT	Trinitrotoluene
TPH	Total Petroleum Hydrocarbons
TRPH	Total Reportable Petroleum Hydrocarbons
TSCA	Toxic Substances Control and Recovery Act
TVH	Total Volatile Hydrocarbons
UNITECH	Universe Technologies
USAF	United State Air Force
USCOE	US Army Corps of Engineers
USEPA	United State Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USMC	United State Marine Corps
UST	Underground Storage Tank



VCP	Voluntary Cleanup Program
VOC	Volatile Organic Compound
VSI	Visual Site Inspection
WLA	Wendy Lopez and Associates
WMP	Waste Management Plan
WPI	Waste Policy Institute

## Quality Program Work Plan (QPWP) - Overview

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The Quality Program Work Plan (QPWP) for Richards-Gebaur Air Force Base (AFB), Kansas City, Missouri, has been prepared in accordance with CH2M HILL's prime contract with the Air Force Center for Environmental Excellence (AFCEE) No. F41624-97-D-8019. The QPWP addresses the Statement of Work (SOW) for Delivery Order (DO) 0090, dated May 24, 1999, entitled, *Basewide Remedial Investigation/Feasibility Study at Richards-Gebaur AFB, Missouri*. It is the principal deliverable required under DO90.

The Remedial Investigation/Feasibility Study (RI/FS) QPWP incorporates two separate plans: a project Health and Safety Plan (HSP) and a project Sampling and Analysis Plan (SAP). The SAP also has two elements: a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). The FSP describes the sampling and analytical methodologies to be used during the RI; the QAPP presents quality assurance/quality control (QA/QC) procedures designed to ensure data usability. A Waste Management Plan (WMP) has also been developed and is incorporated within the overall FSP. The plans are described in further detail in the following sections.

# TAB

1. *Introduction*

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# 1.0 Introduction

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The following paragraphs introduce the regulatory and historical background of the current RI/FS project at Richards-Gebaur AFB.

## 1.1 Institutional Background

To ensure compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA – commonly referred to as Superfund) and the 1986 Superfund Amendments and Reauthorization Act (SARA), the Department of Defense (DoD) developed the Installation Restoration Program (IRP) under the Defense Environmental Restoration Program. The intent of the IRP is to identify potentially contaminated sites, investigate the sites, and evaluate and select the most appropriate remedial actions.

The IRP is DoD's primary mechanism for response actions on U.S. Air Force installations affected by the provisions of SARA. In November 1986, in response to SARA and other U.S. Environmental Protection Agency (EPA) interim guidance, the U.S. Air Force modified the IRP to provide for an RI/FS program that allowed the RI and FS project elements to be conducted in parallel rather than in succession. The IRP includes determining Applicable or Relevant and Appropriate Requirements (ARARs), identifying and screening remedial technologies, and developing site-specific remedial alternatives. The program can include multiple field activities and pilot studies prior to a detailed final analysis of alternatives.

Since its inception, the IRP has been developed and modified to ensure DoD compliance with companion federal laws. Examples of such laws include the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), the Clean Air Act (CAA), the Safe Drinking Water Act (SDWA), the Toxic Substances Control Act (TSCA), and the Emergency Planning and Community Right-to-Know Act (EPCRA).

## 1.2 Project Background

Over the past 16 years, more than 50 environmental projects have been completed at Richards-Gebaur AFB. Some involved removing and upgrading underground storage tanks (USTs); some were in response to known chemical releases; and some were designed to evaluate suspected environmental impacts to soil and groundwater resulting from past industrial practices at the Base. During this period, Richards-Gebaur AFB was designated one of the national Base Realignment and Closure (BRAC) installations. Consequently, the sites at Richards-Gebaur AFB have been investigated primarily under the Air Force IRP, considering various applicable State of Missouri and Federal environmental programs and guidelines, in particular CERCLA. State environmental programs are implemented by the Missouri Department of Natural Resources (MDNR) who, together with the EPA, oversee and approve environmental actions at the Base.

The primary goal of the IRP is *“to complete response actions at contaminated sites so that risks to human health and the environment from contamination are reduced to acceptable levels.”* It follows that the intention of the Air Force at Richards-Gebaur AFB is to continue to protect human health and the environment and enable the property to be successfully

transferred to new owners. Therefore, the Air Force goal is to close each site in compliance with relevant Federal, State, and local requirements.

In 1998, the Air Force authorized an Evaluation and Consolidation Study (ECS) that reviewed and evaluated the historical records of past environmental studies at Richards-Gebaur. The major objective of the ECS was to compile, evaluate, summarize, and present data from the previous investigations in a format that consolidated the past information in a single reference document and offered recommendations for future action. The ECS assessed the environmental condition and regulatory status of each of the 23 IRP sites at the Base. Sites that were considered to satisfy applicable closure criteria were assigned No Further Response Action Planned (NFRAP) status.

A second objective of the study was to identify any additional work required at the installation to achieve regulatory closure of the remaining IRP and UST sites that did not meet appropriate NFRAP closure criteria. This resulted in a data needs analysis that made site-specific recommendations for future work to achieve NFRAP status and site closeout.

Through the process of examining the individual sites for possible NFRAP consideration, it became evident that the sites had been historically evaluated separately from one another. In other words, the individual sites had not been comparatively or systematically assessed within the broader context of the overall Base environment. The purpose of the RI/FS is to address this shortcoming by integrating available site-specific chemical data within the hydrogeological setting of the Base. The QPWP provides the methodologies for accomplishing this goal.

## 1.3 Project Setting

Richards-Gebaur AFB, a former Air Force Reserve Station, is located in west-central Missouri, approximately 18 miles south of downtown Kansas City, and 3 miles east of the Kansas-Missouri State line. The northern portion of the Base is located in Jackson County, and the southern part in Cass County. The Base is surrounded by the City of Belton on the east and south, and is bounded by Kansas City to the north and west.

Richards-Gebaur AFB is located within the Osage Plains region of the Central Lowland physiographic province. The Osage Plains are characterized by low relief, wide, maturely dissected uplands, and relatively steep valley slopes carved on sedimentary rocks of Pennsylvanian age. The topography of the Base is gently rolling, with ground surface elevations ranging from 960 feet above mean sea level (MSL) on the northeast side of the Base to over 1,125 feet MSL on the south property margin. The Base is situated on a broad plateau called the Blue Ridge, with the Blue River bordering to the west and the Little Blue River to the east. Both rivers are confluent to the Missouri River about 20 miles north of the Base. Figure 1.1 shows the setting of Richards-Gebaur AFB.

## 1.4 Base History

Richards-Gebaur AFB was originally farmland. In 1941, the City of Kansas City, Missouri acquired the property for use as an auxiliary municipal airport, and the property was designated Grandview Airport. In 1952, the Central Air Defense Command (ADC) leased Grandview Airport from Kansas City; by 1953, the property was officially conveyed to the United States government.

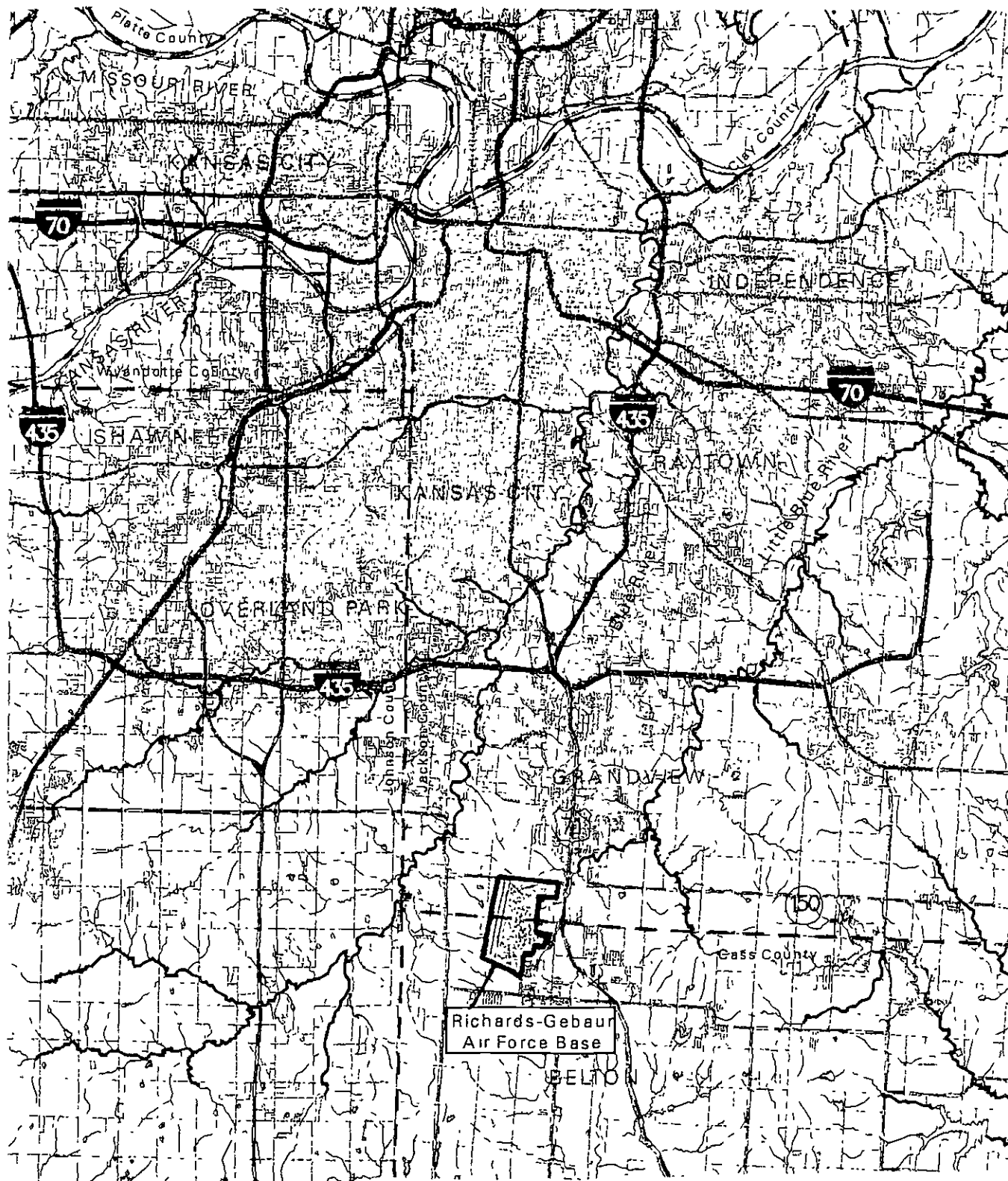


Figure 1.1

# REGIONAL MAP OF RICHARDS-GEBAUR AFB

Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

PLOT DATE 10-26-98

21 DWG

AFTER USACE, 1998

In 1957, Grandview Airport was renamed Richards-Gebaur AFB in honor of First Lieutenant John F. Richards II, who died in combat in World War I, and Colonel Arthur W. Gebaur, who was killed in the Korean War. Both pilots were from Kansas City.

The ADC had the primary mission on the Base until 1970 when the Air Force Communications Command (AFCC) relocated its headquarters from Scott AFB, Illinois, to Richards-Gebaur AFB. The Military Airlift Command (MAC) took control of the Base in 1977 as the AFCC returned its headquarters to Scott AFB. In 1980, the Air Force Reserve assumed operational control of the Base and about 80 percent of the Base property was transferred to the General Services Administration (GSA). The GSA subsequently transferred these properties to the Kansas City Aviation Department, the Federal Aviation Administration, the City of Belton, the Department of the Navy, and the Department of the Army. An interim lease with Kansas City Aviation Department went into effect, allowing joint use of the airport. In 1985, Kansas City acquired 1,360 acres of the former Base property. Since that time, the property has supported both public and military uses (USAF, 1994).

Richards-Gebaur AFB was recommended for closure by the 1991 Defense Base Closure and Realignment Commission (DBCRC) and the recommendation was accepted on July 12, 1991. Air Force mission at the Base ended on September 30, 1994. The Base was known as Operating Location Q (OL-Q) until its formal closure in September, 1998.

Richards-Gebaur AFB presently comprises 426 acres of land distributed in 11 parcels. The largest parcel is the Cantonment Area, the operational center of the Base, which is 208 acres in size. The Belton Training Complex, located approximately four miles south of the Cantonment Area, consists of 184 acres of largely undeveloped land.

The remaining acreage is subdivided into nine parcels ranging between one acre and 13 acres in size. Three safety easements are also held by the Air Force: a 20-acre easement adjacent to the Small Arms Range; a 106-acre easement surrounding the Weapons Bunker; and a 287-acre easement around the Belton Training Complex. Much of the original Base has been transferred to other entities, including the City of Kansas City and the City of Belton.

# TAB

2.0 Objectives and Scope of RI/FS



## 2.0 Objectives and Scope of RI/FS

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The Basewide RI/FS consists of two principal efforts: (1) characterizing risks posed to human health and the environment by the presence of residual site chemicals; and (2) given that unacceptable risks exist, identifying and evaluating the most reasonable remedial alternative to address those risks. The former effort corresponds with the RI. The latter effort constitutes the FS, although overlap does occur and, in some cases, is desirable to expedite the overall project schedule. The RI and FS elements are discussed separately.

### 2.1 Remedial Investigation (RI)

The objectives of the RI are to:

1. Characterize the occurrence of Chemicals of Concern (COC) at individual sites
2. Determine the underlying geology at individual sites
3. Estimate the hydraulic gradient, groundwater flow direction, and groundwater flow rate at individual sites
4. Evaluate the hydrogeology of the Base
5. Refine the basewide Conceptual Site Model (CSM) based upon new data
6. Characterize the risks posed by the sites to human health and the environment

These objectives are consistent with the longer-term goals of individual site closure (via the NFRAP process) and, ultimately, transfer of the Base property to the private or public sector.

The scope of the RI consists of five main tasks:

- Fieldwork
- Laboratory Analysis
- Data Validation
- Data Evaluation
- Reporting

Other tasks – such as chemical fate and transport modeling, natural attenuation modeling, health risk assessment, and ecological risk assessment - are also included within the scope of the RI. However, the effort involved with these tasks depends largely upon the results of the field investigation. Therefore, it is difficult to predict at this time the scope, if any, of these tasks.

The main RI tasks are summarized below. Further details are given in the FSP that follows. **Figure 2.1** shows the location of the 16 RI/FS sites at Richards-Gebaur AFB.

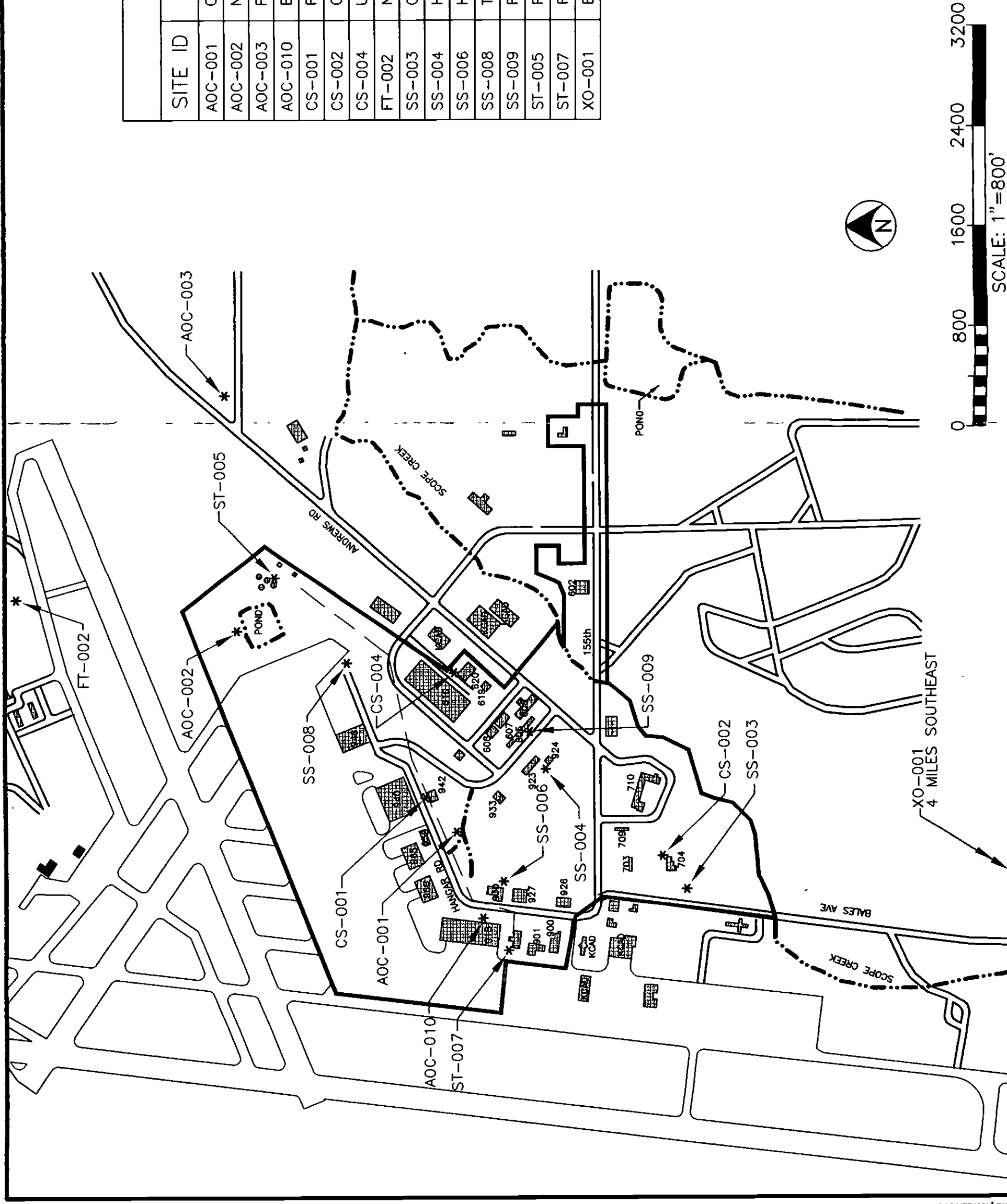


Figure 2.1

# GENERAL SITE PLAN

Richards—Gebaur AFB  
Kansas City, Missouri

### 2.1.1 Fieldwork

The Richards-Gebaur RI involves a significant amount of fieldwork, scheduled to take place over a two-to-three month period. The scope of the RI field effort comprises:

- Drilling and installing approximately 30 groundwater monitoring wells
- Drilling approximately 30 soil borings that are not converted into monitoring wells
- Collecting approximately 70 groundwater samples
- Collecting approximately 120 soil samples
- Collecting approximately 20 surface water samples
- Collecting approximately 20 sediment samples

Following installation of the monitoring wells, a field survey will be conducted to accurately locate the wells on the base map

### 2.1.2 Laboratory Analysis

CH2M HILL has contracted with Columbia Analytical Services (CAS), Redding, CA, to perform the sample analyses. CAS is experienced with AFCEE QAPP requirements and, based on similar previous project experience, can satisfy the RI/FS Data Quality Objectives (DQOs).

The environmental samples will be analyzed for a suite of parameters including total petroleum hydrocarbons (TPH); volatile organic compounds (VOCs), including benzene, toluene, ethylbenzene, and xylenes (BTEX); semi-volatile organic compounds (SVOCs); target analyte list (TAL) metals; and polychlorinated biphenyls (PCBs). In addition, natural attenuation parameters will be analyzed in groundwater samples from four of the 16 sites where organic compounds have been detected in groundwater.

### 2.1.3 Data Validation

Upon receipt of the laboratory data, the electronic data is validated according to the five measures of data quality defined in the project-specific QAPP – precision, accuracy, representativeness, completeness, and comparability (PARCC). Analytical data that do not meet the criteria will be flagged accordingly. Data Quality Evaluation Reports are subsequently generated.

Related database management activities include database setup, input of laboratory electronic data, incorporation of data validation flags into the corresponding data records, and QA/QC of the database, electronic data, and hardcopy data. All analytical data, including QC results and cross-reference tables, will be submitted in hard and electronic copies.

Electronic boring log files are created for input into the Air Force's Environmental Resources Program Information Management System (ERPIMS), and project-specific data tables are generated for use in project reports. QC of ERPIMS deliverable is performed prior to ERPIMS submission. ERPIMS data files will be submitted in accordance with schedules and sequences set forth in the current version of the ERPIMS Data Handbook.

## 2.1.4 Data Evaluation

Analytical data will be generated for 16 individual sites and several other Base locations detailed in the Basewide RI/FS SOW. This data will supplement existing data at each of the RI/FS sites. The new data will be evaluated against the existing site data and updated data summary tables created for each site. The resulting expanded site databases will be compared to ARARs and available risk-based cleanup criteria such as the Cleanup Levels for Missouri (CALM) Guidance. The ability of individual sites to satisfy regulatory closure criteria will be re-evaluated, and remaining data needs (such as risk assessment or fate and transport modeling) will be identified.

In addition, groundwater elevation data will be measured on a monthly basis for approximately 85 monitoring wells. These measurements will be made over a period of at least one year. It is the intent to combine the groundwater elevation data with the monitoring well survey data to create a basewide groundwater contour map. Individual site groundwater contour maps will also be created to evaluate site-specific hydraulic gradients, groundwater flow directions, and estimates of groundwater flow rates.

In addition, seasonal variations in hydrogeology will also be evaluated using the groundwater elevation data. Inconsistent up-or-down fluctuations in groundwater elevations in response to seasonal trends may help distinguish locally perched water conditions.

The groundwater elevation and survey data will then be combined with the location-specific analytical data to create an electronic Geographic Information System (GIS) database. The GIS database will be used to graphically present spatial and temporal contaminant distributions. Site-specific contaminant concentration maps will be developed as necessary to support proposed NFRAP decisions or other plans, such as remedial action plans.

GIS will also be used to help visualize the hydrogeology of Richards-Gebaur AFB, and to refine the Conceptual Site Model. The updated CSM may then be used to support potential follow-on activities such as chemical fate and transport modeling and quantitative risk assessment.

## 2.1.5 Chemical Fate and Transport Modeling

In the event that the data indicates that groundwater contains concentrations of COC above applicable target concentrations, chemical fate and transport modeling would be conducted to assess the likelihood that contaminants could migrate offsite and reach potential human or ecological receptors.

The ability to successfully apply groundwater modeling depends on the quality and range of key input parameters. Based upon the results of previous studies at Richards-Gebaur AFB, parameters such as hydraulic gradients and groundwater flow velocities have historically been difficult to estimate. Other parameters – for example, hydraulic conductivity or biodegradation rates - have not been evaluated at the Base to date.

The data produced during the RI/FS will allow many of these parameters to be assessed. For example, groundwater elevations will be used to help estimate ranges of hydraulic conductivity, and natural attenuation chemical indicators will be measured at four sites with suspected organic groundwater contamination. This new data, together with the ability to manipulate it using GIS, potentially provides for the application of contaminant fate and transport modeling during the RI/FS. In addition to groundwater flow, such modeling may also include vadose zone transport and natural attenuation modeling.

## 2.1.6 Risk Assessment

Additional data indicating the occurrence and distribution of chemicals in soil, groundwater, sediment, and surface water will be evaluated and incorporated into the CSM. Groundwater level data collected on a monthly basis will be electronically input into the site database and hydrological parameters such as hydraulic gradient, groundwater flow direction, and groundwater flow velocities estimated for individual sites and also on a basewide scale.

The RI-derived data will be reviewed along with historical site data to re-evaluate potential human and ecological receptor exposure scenarios for the 16 sites. Semi-quantitative risk assessments will be conducted to evaluate site chemical concentrations relative to applicable risk-based cleanup goals. If warranted, additional quantitative risk assessments will be performed to develop site-specific risk-based cleanup targets. Quantitative risk assessments will be conducted in accordance with the Risk Assessment Guidance for Superfund – RAGS (USEPA, 1989). Risk assessments may also be conducted, with the approval of the BCT, in accordance with applicable MDNR CALM Tier 2 and Tier 3 guidelines.

Ecological risk assessments will be undertaken as needed on a site-specific basis. Qualitative assessments will be conducted for each site being addressed through the CALM process. If the qualitative assessment indicates that potential ecological receptors may be at risk, a quantitative assessment may be conducted. The ecological risk assessments will conform to the methodologies presented in Appendix F of the CALM guidance document.

## 2.1.7 Reporting

Internal draft, draft, draft final, and final RI reports will be prepared. The reports will describe the RI fieldwork, the results of the sample analyses, and the outcome of site-specific risk assessment. A revised CSM will be presented along with a detailed evaluation of individual site and basewide hydrogeology. The RI report will comply with the specifications, procedures, and methodologies presented in the applicable Field Sampling Plans, and will be consistent with applicable MDNR and USEPA guidance. The final RI Report will be made available for public comment.

In addition, where appropriate, internal draft, draft, draft final, and final NFRAP Decision Documents will be prepared. The final report will reflect regulatory and Air Force comments and make recommendations for final site disposition consistent with the site-specific sampling results and risk assessment.

CH2M HILL will prepare NFRAP Decision Documents for sites that have been adequately characterized and, based upon comparison of the data with applicable CALM target concentrations, are judged to no longer pose risks to public health and the environment. NFRAP documents will be stand-alone and use site-specific data to support and justify recommendations for site closure. The NFRAP documents will reflect regulatory agency and Air Force comments. The sites that are judged to pose risks to human health and the environment, and cannot satisfy NFRAP criteria, will be considered in the FS.

## 2.2 Feasibility Study (FS)

The objective of the FS is to identify the most appropriate remedy for a contaminated site. The FS element of the Basewide RI/FS will address only those sites that cannot satisfy applicable MDNR CALM closure criteria based upon the results of the RI. Thus, the scope

of the FS will depend upon the number of sites that fail to satisfy applicable closure criteria, and the degree and extent of contamination remaining at the individual sites.

The FS process begins by developing a list of candidate remedial responses. The initial list is screened to identify the five most promising remedial technologies, and the results presented in an Initial Screening of Alternatives report. When the five remedial alternatives are agreed upon by the regulators and the Air Force, a formal evaluation is conducted according to nine established EPA criteria. The final remedy is then selected, documented and the FS report is prepared.

Occasionally, a remedial alternative cannot be adequately evaluated because the success of the remedial alternative is critically dependent upon site-specific physicochemical and microbiological conditions. In these circumstances, treatability studies are undertaken. These can include bench tests, pilot-scale tests, and field tests. The test results are documented and a treatability study report is written. The treatability study report is incorporated within the FS report. The main FS tasks are summarized below.

### **2.2.1 Develop Remedial Alternatives**

Following evaluation of the RI results, general remedial response actions that appear to satisfy remedial action objectives are identified. General response actions are typically selected for their ability to reduce either chemical concentrations or the likelihood of exposure. The selections may include no action, long-term monitoring, institutional controls, containment, removal, treatment, and disposal. A list of specific technologies that satisfy each response action will be generated and evaluated for compatibility with individual site conditions and the chemicals of concern.

### **2.2.2 Screen Remedial Alternatives**

A secondary screening process will be conducted to reduce the number of viable alternatives for more detailed evaluation. The technologies will be screened based upon effectiveness, implementability, and cost effectiveness. Five alternatives will be identified for each site under consideration in the FS. An Initial Screening of Alternatives Technical Report will be prepared to document the remedial alternative selection process.

### **2.2.3 Evaluate Remedial Alternatives**

The selected remedial alternatives will be evaluated according to nine standard criteria:

1. Overall protection of human health and the environment
2. Compliance with ARARs
3. Long-term effectiveness and permanence
4. Reduction in toxicity, mobility, or volume
5. Short-term effectiveness
6. Implementability
7. Cost
8. State acceptance
9. Community acceptance

### **2.2.4 Selection of Remedy/Documentation**

On the basis of the alternatives analysis, a preferred remedial action will be selected for each site. The detailed analysis of alternatives will be documented in sufficient detail to

adequately support the selection of the preferred remedial action, and will be incorporated into the final FS report. Proposed Plans and Decision Documents will be prepared according to OSWER 9355.3-02.

## **2.2.5 Treatability Studies**

Treatability studies include work plan development, bench scale tests, pilot studies, and field tests. The studies are conducted to allow the Air Force and regulators to determine the feasibility of various environmental processes at sites requiring remediation. The results of the studies and tests will be incorporated into the FS report.

### **2.2.5.1 Develop Treatability Work Plan**

A treatability work plan will be developed for each technology evaluated. The work plan will describe the objectives and scope of the proposed test, and provide a schedule for implementation. The work plan will be submitted to the BCT for their review and approval. The scope of the treatability tests depends on physical site conditions, the COC, the remedial technology, and the remedial action goals.

### **2.2.5.2 Bench Test**

Bench tests will be run for those technologies that require site-specific physicochemical data to ascertain their applicability.

### **2.2.5.3 Pilot Scale Test**

If the remedial technology satisfies the Bench Test, a Pilot Scale Test is conducted to evaluate the implementability of the technology under site conditions

### **2.2.5.4 Field Test**

For technologies that fulfill the requirements of Bench Tests or Pilot Scale Tests or both, Field Tests are designed to assess the feasibility of applying the remedial technology under actual site conditions.

### **2.2.5.5 Document Treatability Study**

A Treatability Study Report will be produced documenting the objectives, scope, and rationale of the treatability study. The report will be included in the final FS report.

## **2.2.6 Document FS**

The FS report will be prepared as internal draft, draft, draft final, and final. It will be a separate report from the RI report. The FS report will incorporate the results of the Initial Screening of Alternatives Report and the detailed analysis of alternatives, document the rationale behind the final remedy selection(s), and present the results of treatability studies. The document will outline possible remedies for sites that cannot meet appropriate cleanup criteria, and it will describe the preferred remedy of the Air Force.

The FS report will be finalized after responding to and incorporating regulatory agency and Air Force comments. The final FS report will be made available for public comment. Following the public comment period, the final remedy will be documented in a Record of Decision, or similar decision document, for the site.

# TAB

## 3. Quality Program Work Plan – Overview



## 3.0 Quality Program Work Plan (QPWP)

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A QPWP is developed and distributed to team members to serve as a project-planning guide for enhancing communications and activities associated with the RI/FS. The QPWP provides a brief description of the project background and summarizes the objectives and scope of the work. In addition, a project Work Breakdown Structure is provided, together with a list of project deliverables, a schedule, and a list showing project team roles and responsibilities.

As indicated above, the QPWP consists of several related plans that address field sampling issues (SAP/FSP), worker health and safety (HSP), and project QA/QC (QAPP). The individual plans describe the applicable methodologies used to collect samples, protect workers from potential hazards, and ensure project DQOs are met. The different plans that make up the QPWP are summarized below. The individual plans are given as separate, stand-alone documents following the QPWP.

### 3.1 Sampling and Analysis Plan (SAP)

A SAP for the 16 sites listed in Annex A to the RI SOW has been prepared in accordance with the current versions of the AFCEE QAPP and AFCEE Technical Services Quality Assurance Program. The SAP consists of a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP).

#### 3.1.1 Field Sampling Plan (FSP)

The FSP contains 16 individual site sampling plans (SSPs). The FSP is organized to give detailed descriptions of the major project elements and tasks that apply to the sites being investigated as part of the RI. The individual FSP sections present information about:

- Project Objectives and Scope
- Project Organization
- Field Methodologies
- Environmental Sampling
- Sample Management
- Field Measurements
- Record Keeping

In addition, the FSP also includes a series of CH2M HILL standard operating procedures (SOPs) for routine field tasks. The SOPs are written consistent with applicable USEPA and MDNR Guidance documents and have been used successfully for similar Air Force projects.

The SOPs for the Basewide RI/FS at Richards-Gebaur AFB are:

- Decontamination of Personnel and Equipment
- Decontamination of Drilling Rigs
- Logging of Soil Borings
- Soil Boring Drilling and Abandonment
- Field Screening for VOCs
- Split-spoon Sampling
- Shallow Soil Sampling
- Sediment Sampling
- Surface Water Sampling
- Homogenization of Soil and Sediment Samples
- Monitoring Well Installation and Development
- Monitoring Well Abandonment
- Groundwater Sampling from Monitoring Wells
- Low-flow Groundwater Sampling
- Water Level Measurements
- Management of Investigation-derived Waste

### 3.1.2 Quality Assurance Project Plan (QAPP)

The Richards-Gebaur AFB Basewide RI/FS QAPP has been prepared by CH2M HILL chemists who specialize in meeting the requirements of the AFCEE Technical Services QAPP (Version 3.0). The purpose of the QAPP is to establish the general QA requirements for the investigations and analyses that occur in support of the Basewide RI/FS. To fulfill this purpose, the scope of the QAPP also includes, by reference, the AFCEE QAPP. This will ensure that the RI/FS QAPP is sufficiently flexible to accommodate the many small and large tasks, site types, and phases of work that constitute the overall project. Additional conceptual guidance for developing the QAPP was derived from the AFCEE *Handbook for the Installation Restoration Program—Remedial Investigations and Feasibility Studies* (IRP Handbook) (AFCEE, 1993).

The QAPP presents the specific policies, organization, functions, and QA/QC activities associated with analytical data generation and assessment. The plan is designed to ensure that the DQOs for the Basewide RI/FS are achieved. Where modifications to the QAPP are proposed, they will be clearly identified in the relevant SSP and FSP, or addenda, and approved by the BCT prior to implementation.

A key component of the data management and analytical generation and assessment process is the Data Management Plan (DMP). The Basewide RI/FS Data Management Plan is outlined in Attachment 1 to the QAPP. The DMP provides operating guidelines for satisfying the data management requirements for large quantities of data.

The DMP includes processes and guidelines for sample tracking, storage, access, delivery, and reporting of new chemical, analytical, geologic, and spatial data generated during Richards-Gebaur AFB RI/FS and subsequent remedial actions. In addition, the DMP addresses the management of historical data.

The Richards-Gebaur Basewide RI/FS QAPP contains the following key elements:

- Quality Objectives
- Field Instrument Calibration Procedures
- Field Procedures
- Reporting Limits
- Clarifications of and Variances from the AFCEE QAPP, Version 3.0

In addition, four attachments are provided to the QAPP:

- Attachment 1—Data Management Plan
- Attachment 2—Quality Control Criteria and Quantitation Limits
- Attachment 3—Method TO-14 Acceptance Criteria
- Attachment 4—Laboratory EDD Format

## 3.2 Health and Safety Plan (HSP)

A project HSP has been prepared to address potential health and safety issues associated with all field activities included in the SOW. The HSP was prepared in accordance with the Hazardous Waste Operations and Emergency Response, Title 29 Code of Federal Regulations Part 1910.120. The plan complies with USAF, OSHA, USEPA, state, and local health and safety regulations regarding the proposed work effort.

The HSP contains brief site descriptions and a summary of the planned RI tasks at each site. Detailed tables list the COC, their concentration ranges (based upon existing site data), their industrial hygiene exposure limits, and typical symptoms and effects of exposure. Other physical and biological hazards are similarly discussed. Personnel training, personal protective equipment, medical surveillance, and medical monitoring programs are detailed. Site control, decontamination procedures, and confined space entry guidelines are also addressed. An emergency response plan is provided to ensure rapid and effective control of unforeseen hazardous situations.

## 3.3 Other Plans

In addition to the above-required plans, other plans may need to be developed, including schedules, Supplemental Work Plans (SWPs), and Waste Management Plans (WMPs). A WMP is provided as part of the FSP; other plans will be developed as required.

### 3.3.1 Waste Management Plan

An IDW management plan is provided as an SOP attachment to the FSP. The field investigation will produce solid and liquid wastes such as drill cuttings from soil borings, and groundwater from monitoring well development. IDW, along with discarded disposable sampling equipment and other debris, will be contained in flexible 1-cubic yard polypropylene containers or DOT-approved 55-gallon drums. At the end of each workday, the waste containers will be moved to a designated staging area and placed upon wooden pallets prior to characterization and offsite disposal.

CH2M HILL has subcontracted the characterization, transportation, and disposal of investigation-derived waste to GSI, Kansas City, KS. The company will be responsible for ensuring that drill cuttings, well development water, and other associated solid and liquid wastes are suitably characterized and containerized prior to transportation and offsite disposal at an appropriately permitted waste disposal facility. CH2M HILL will coordinate waste disposal efforts with the Richards-Gebaur Point of Contact (POC).

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*4. QPWP Organization*

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## 4.0 QPWP Organization

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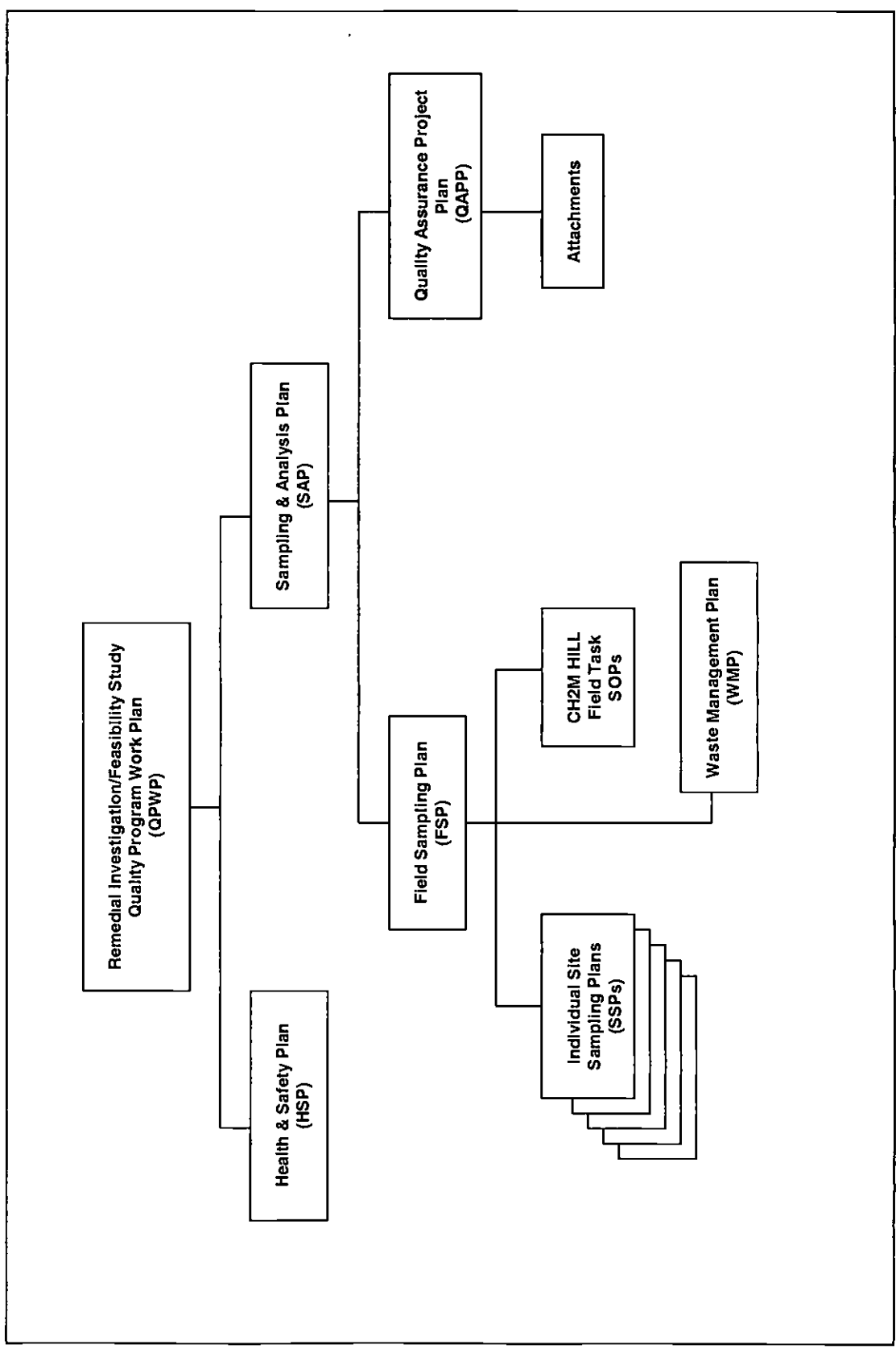
**Figure 4.1** illustrates the hierarchy and interrelationship between the plans that constitute the Richards-Gebaur AFB Basewide RI/FS QPWP. The QPWP is organized in two parts. Part 1 is the project Health and Safety Plan (HSP). Part 2 is the project Sampling and Analysis Plan (SAP).

The SAP also consists of two documents – the Quality Assurance Project Plan (QAPP) and the Field Sampling Plan (FSP).

The FSP presents the RI/FS sampling methodologies, the analytical parameters, and the investigation design rationale. Following detailed descriptions of the RI/FS methodologies, individual Site Sampling Plans (SSPs) are provided for each of the 16 sites that are under investigation. In support of the FSP, CH2M HILL Standard Operating Procedures for critical field tasks are included as attachments.

Other plans may also be required during the RI/FS. One such plan is a Waste Management Plan (WMP) that describes the handling, storage, and disposal of investigation-derived waste (IDW). The WMP is provided as an SOP attachment to the FSP and may be modified based upon input from the AFB POC and the waste management subcontractor.

Figure 4.1 – QPWP Organization



# TAB

*5. Project Organization*

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## 5.0 Project Organization

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The identities and roles of the principal project team members are as follows:

*Mike Nicklow* - Base Realignment and Closure (BRAC) Environmental Coordinator (BEC)

*Robert Koke* – USEPA Region VII

*Jim Harris* – Missouri Department of Natural Resources (MDNR)

*Kay Grosinske* – AFCEE Team Chief

*Jill Benefield* – AFCEE Contract Specialist

*Dave Malecki* – Installation Point of Contact (POC)

*Ed Baker* – Booz-Allen

*Sabina Chowdhury* – Waste Policy Institute (WPI)

*George Bauml* – Universe Technologies (UNITECH)

*Peter Barrett* – Project Manager (CH2M HILL)

*Ning Li* – Field Team Leader and Site Safety Coordinator (CH2M HILL)

*Mark Cichy* – Project Chemist (CH2M HILL)

*Dale Cira* – Senior Regulatory Advisor (Van Breusegen & Associates)

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*6. Schedule*

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## 6.0 Schedule

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The project schedule is provided in the attached figure. Key milestone events are:

- October 25, 1999      Begin Remedial Investigation (RI) Fieldwork
- December 29, 1999      End RI Fieldwork
- April 3, 2000      Begin Feasibility Study (FS)
- June 13, 2000      Submit Draft RI Report
- August 10, 2000      Begin Treatability Studies
- December 29, 2000      Submit Final RI Report
- March 7, 2001      Submit Treatability Studies Report
- June 29, 2001      Submit Draft FS Report
- November 29, 2001      Submit Final FS Report
- May 6, 2002      Project ends

The project schedule will inevitably be revised in response to unpredictable project demands. Once recognized, potential revisions to the RI/FS project schedule will immediately be communicated to the Air Force so that the changes can be evaluated and, where appropriate, efficiently accommodated within the overall schedule to minimize impacts upon the milestone dates.

Richards-Gebaur Air Force Base  
F41624-97-D-8019-0090

ID	Task Name	Duration	Start	Finish
1	(02) Project Management	1046ed	Fri 6/25/99	Mon 5/6/02
2	(02 01) Conduct Project Management	1046ed	Fri 6/25/99	Mon 5/6/02
3	(02 02) Support Subcontracting Activities	1046ed	Fri 6/25/99	Mon 5/6/02
4	(02 03) Administration/Reporting	1046ed	Fri 6/25/99	Mon 5/6/02
5	(05) Regulatory Interaction	1046ed	Fri 6/25/99	Mon 5/6/02
6	(05 01) Monthly BCT Meetings & Qtrly RAB Migs	1046ed	Fri 6/25/99	Mon 5/6/02
7	(06) Field Investigation	436ed	Wed 10/20/99	Fri 12/29/00
8	(06 01) Land Survey	20ed	Thu 11/25/99	Wed 12/15/99
9	(06 02) Mobilization	2ed	Wed 10/20/99	Fri 10/22/99
10	(06 02) Demobilization	1ed	Wed 12/29/99	Thu 12/30/99
11	(06 04) Sample Collection	58ed	Mon 10/25/99	Wed 12/22/99
12	(06 05) Install Monitoring Wells	51ed	Mon 10/25/99	Wed 12/15/99
13	(06 07) Derived Waste Disposal	27ed	Thu 12/2/99	Wed 12/29/99
14	(06 09) Conduct Ecological Investigation	209ed	Thu 6/1/00	Wed 12/27/00
15	(08) Offsite Laboratory Sample Analysis	124ed	Mon 10/25/99	Sat 2/26/00
16	(08 01) Analyze Lab Samples	124ed	Mon 10/25/99	Sat 2/26/00
17	(10) Analytical Support/Data Validation	157ed	Mon 11/1/99	Thu 4/6/00
18	(10 05) Data Validation	157ed	Mon 11/1/99	Thu 4/6/00
19	(11) Data Evaluation	392ed	Wed 12/1/99	Wed 12/27/00
20	(11 02) Data Reduction, Tabulation, and Eval	182ed	Wed 12/1/99	Wed 5/31/00
21	(11 03) Contaminant Fate and Transport Modeling	177ed	Mon 7/3/00	Wed 12/27/00
22	(12) Risk Assessment	177ed	Mon 7/3/00	Wed 12/27/00
23	(12 02) Site Conceptual Model	177ed	Mon 7/3/00	Wed 12/27/00
24	(13) Document Assessment	301ed	Wed 3/1/00	Wed 12/27/00

Richards-Gebaur Air Force Base  
F41624-97-D-8019-0090  
Remedial Investigation/Feasibility Study

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ID	Task Name	Duration												Start		Finish																															
25	(13 01) Compose Draft RI Report	101ed												Wed 3/1/00		Sat 6/10/00																															
26	(13 03) Finalize Report	198ed												Mon 6/12/00		Wed 12/27/00																															
27	(14) Alternative Evaluation	249ed												Fri 4/7/00		Tue 12/12/00																															
28	(14 01) Develop Remedial Alternatives	120ed												Fri 4/7/00		Sat 8/5/00																															
29	(14 02) Screen Remedial Alternatives	62ed												Wed 7/19/00		Tue 9/19/00																															
30	(14 03) Evaluate Remedial Alternatives	60ed												Mon 9/4/00		Fri 11/3/00																															
31	(14 04) Selection of Remedy/Documentation	39ed												Fri 11/3/00		Tue 12/12/00																															
32	(15) Treatability Studies	209ed												Thu 8/10/00		Wed 3/7/01																															
33	(15 02) Develop Treatability Work Plan	63ed												Thu 8/10/00		Thu 10/12/00																															
34	(15 03) Bench Test	41ed												Fri 10/13/00		Thu 11/23/00																															
35	(15 04) Pilot Scale Test	41ed												Fri 10/13/00		Thu 11/23/00																															
36	(15 05) Field Test	76ed												Fri 11/24/00		Thu 2/8/01																															
37	(15 06) Document Treatability Study	33ed												Fri 2/2/01		Wed 3/7/01																															
38	(16) Document FS	378ed												Wed 12/13/00		Wed 12/26/01																															
39	(16 01) Compose Draft FS Report	198ed												Wed 12/13/00		Fri 6/29/01																															
40	(16.03) Finalize Report	142ed												Sat 6/30/01		Mon 11/19/01																															
41	(17) Post Assessment Report	929ed												Wed 10/20/99		Mon 5/6/02																															
42	(17 02) Prepare Presentation Materials	929ed												Wed 10/20/99		Mon 5/6/02																															
43	(17 03) Decision Document	168ed												Mon 11/19/01		Mon 5/6/02																															

# TAB

*SAP Part I - Field Sampling Plan*

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**Installation Restoration Program  
Basewide Remedial Investigation / Feasibility Study Work Plan  
for  
Richards-Gebaur Air Force Base**

**SAMPLING AND ANALYSIS PLAN  
(includes Field Sampling Plan and Quality Assurance Project Plan)**

October 1999

Prepared for

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USAF Contract No F41624-97-D-8019  
Delivery Order 0090

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## **Appendix A -- Site Sampling Plans**

AOC 001: Central Drainage Area  
AOC 002: North Drainage Area  
AOC 003: Firing Range  
AOC 010: Building 918 Parking Lot  
CS 001: Fuel Line – 942 Section  
CS 002: Oil / Water Separator at Building 704  
CS 004: UST 620A  
FT 002: North Burn Pit (FTA)  
SS 003: Oil Saturated Area  
SS 004: Hazardous Waste Drum Storage Area  
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SS 008: Test Cell Area  
SS 009: Fire Valve Area  
ST 005: Petroleum, Oil, and Lubricants (POL) Storage Yard  
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## **Appendix B -- Standard Operating Procedures**

Decontamination of Personnel and Equipment  
Logging of Soil Borings  
Soil Boring Drilling and Abandonment  
Monitoring Well Installation and Development  
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Disposal of Waste Fluids and Solids  
Water Level Measurements  
Groundwater Sampling from Monitoring Wells  
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**Appendix B – Standard Operating Procedures (Continued)**

Shallow Soil Sampling

Surface Water Sampling

Sediment Sampling

Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, and Temperature using the Horiba® U-10

**Appendix C – Example Field Forms**

# TAB

*Sampling and Analysis Plan – Overview*

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# Sampling and Analysis Plan - Overview

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The Sampling and Analysis Plan (SAP) presents the requirements and methodologies for conducting field work at Richards-Gebaur Air Force Base (AFB) during the Basewide Remedial Investigation/Feasibility Study (RI/FS). The RI/FS will be conducted under Contract Number F41624-97-D-8019/0090 in accordance with the project Statement of Work (SOW) dated May 19, 1999. The RI/FS SAP consists of a Field Sampling Plan (FSP) and a project Quality Assurance Project Plan (QAPP). The SAP in combination with the associated project Health and Safety Plan (HSP) form the overall Quality Assurance Project Plan (QPWP).

The National Contingency Plan (NCP) specifies circumstances under which a FSP is necessary for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions. For remedial response actions at the RI/FS stage, the NCP requires lead agents to develop sampling and analysis plans that provide a process for obtaining data of sufficient quality and quantity to satisfy data needs. Such sampling and analysis plans must include a field sampling plan, as required by 40 Code of Federal Regulations (CFR) 300.430 (b)(8)(ii). Accordingly, the work conducted during the RI/FS will conform to applicable US Environmental Protection Agency (EPA) guidelines and applicable Missouri Department of Natural Resources (MDNR) guidelines.

The SAP is divided into two parts. Part 1 is the FSP and immediately follows this overview. Part two is the QAPP. The QAPP is provided as a separate document.

# TAB

*1. FSP Introduction*

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# 1.0 FSP Introduction

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The FSP was developed following the guidelines set forth in *Data Quality Objectives Process for Superfund, Interim Final Guidance* (U.S. Environmental Protection Agency [EPA], 1993). The FSP is written to ensure that:

- the data quality objectives (DQOs) specified for the project are met
- the field sampling and analytical methodologies are documented and reviewed in a consistent manner
- the data collected are scientifically valid and defensible

The FSP conforms to the Air Force Center for Environmental Excellence (AFCEE) Quality Assurance Project Plan (QAPP) Version 3.0. Taken together, the FSP and the QAPP constitute the RI/FS SAP.

The FSP will be read by field workers participating in the Basewide RI/FS at Richards-Gebaur AFB, and will be kept in the possession of the field teams as the field work is conducted. All contractors and subcontractors will be required to comply with the procedures documented in the FSP to maintain comparability and representativeness of the field data.

The Basewide RI/FS at Richards-Gebaur AFB addresses the 16 individual sites that are listed in the project SOW. The FSP has been organized to provide a uniform set of RI/FS methodologies that apply in general to all sites. These methodologies are supported by a series of standard operating procedures (SOPs) that support the FSP. To accommodate differing site conditions, sixteen Site Sampling Plans (SSPs) have been prepared that summarize individual site histories and identify site-specific objectives and scopes of work. The SSPs are provided as stand-alone documents that will be used in the field at each site. The individual SSPs incorporate by reference the detailed field and analytical methodologies that are described in the FSP and QAPP. They are provided as Appendix A to the FSP.

The FSP constitutes Part 1 of the SAP. The QAPP is provided separately and constitutes Part 2 of the SAP.



# TAB

*2.0 Project Objectives and Scope*

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## 2.0 Project Objectives and Scope

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### 2.1 Field Sampling Objectives

The objectives of the RI/FS field work are to:

- Characterize the occurrence of Chemicals of Concern (COC) at individual sites
- Determine the underlying geology at individual sites
- Estimate the hydraulic gradient, groundwater flow direction, and groundwater flow rate at individual sites
- Evaluate the hydrogeology of the Base
- Refine the basewide Conceptual Site Model (CSM) based upon new data
- Characterize the risks to human health and the environment posed by each site

These objectives are consistent with the longer-term goals of individual site closure and submission of No Further Response Action Planned (NFRAP) Decision Documents, and final transfer of the Base property to the private or public sector.

Site-specific field work objectives are provided in the attached individual SSPs in Appendix A. The individual SSPs also contain site figures that depict the site location, existing monitoring/sampling locations, and proposed RI/FS monitoring/sampling locations.

### 2.2 Data Quality Objectives (DQOs)

DQOs are pre-established goals that help monitor and assess the progress of the project. They provide the benchmarks against which the quality of field work and the quality of resulting analytical data are evaluated.

DQOs specify the data type, quality, quantity, and uses needed to support RI/FS decisions. The 1999 Richards-Gebaur AFB Evaluation and Consolidation Study identified data needs at individual sites. The additional data is required either to further characterize site conditions or to validate previous response actions. Data describing the occurrence and distribution of COC in surface soil, subsurface soil, sediment, surface water, and groundwater are needed. The data will be used to support feasibility studies, risk assessment, fate and transport modeling, remedial action, and, ultimately, site closure. Consequently, the quality and quantity of the data must be sufficient to:

- allow comparison of analytical data with MDNR and EPA risk-based criteria
- satisfy input parameters for risk assessment and fate and transport modeling
- evaluate remedial alternatives (e.g. bioremediation, natural attenuation)
- provide sufficient site characterization and remedial action verification in accordance with applicable MDNR Cleanup Levels for Missouri (CALM) target concentrations to support NFRAP or other Decision Documents

The development of DQOs occurs in parallel with the preparation of the project QAPP to ensure that the appropriate sample analytical methods are selected.

Analytical methods are specified in the FSP to ensure that the analytical detection limits are commensurate with the data uses identified above. For example, if the purpose of a monitoring program is to demonstrate that remediation cleanup levels are being met, then the analytical quantitation limit must be at least as low as the applicable cleanup level. Sometimes, method detection limits are higher than project ARARs. In this case, detection level limitations will be considered during the decision-making process.

**Table 2-1** and **Table 2-2** are DQO summary tables that list the COCs identified for the RI/FS and their applicable CALM action levels for soil (Scenario B) and groundwater. The AFCEE QAPP reporting limits are provided for each COC along with the corresponding laboratory detection limits.

**Table 2-1 Data Quality Objectives Summary for Groundwater**  
**Richards-Gebaur AFB**

Chemicals of Concern	GTARC (ppm)	AFCEE Reporting Limit (ppm)	CAS Lab Detection Limit (ppm)
<b>Metals (Method SW 6010B)</b>			
Barium	2	0.005	0.001
Cadmium	0.005	0.007	0.002
Chromium	0.1	0.01	0.002
Nickel	0.1	0.01	0.008
<b>Metals (Method SW 7000 Series)</b>			
Lead	0.015	0.005	0.0005
Mercury	0.002	0.001	0.0001
Thallium	0.002	0.001	0.0008
<b>VOCs (Method 8260B)</b>			
Benzene	0.005	0.0004	0.00008
1,1-dichloroethene	0.007	0.0012	0.00009
cis 1,2-Dichloroethene	0.007	0.0012	0.0001
Tetrachloroethene	0.005	0.0014	0.00012
Trichloroethene	0.005	0.001	0.0001
Vinyl chloride	0.002	0.0011	0.00007
<b>SVOCs (Method 8270C)</b>			
Bis(2-ethylhexyl)phthalate	0.006	0.01	0.0014

Note: GTARC = groundwater target concentration

**Table 2-2 Data Quality Objectives Summary for Soil**  
**Richards-Gebaur AFB**

Chemicals of Concern	Tier 1 Scenano B STARC		AFCEE Reporting Limit (ppm)	CAS Lab Detection Limit (ppm)
	C <sub>IDI</sub> (ppm)	C <sub>leach</sub> (ppm)		
Metals (Method SW 6010B)				
Barium	3930	1650	1.0	0.1
Beryllium	0.07	130	1.0	0.1
Cadmium	120	11	0.50	0.1
Manganese	7160	NA	2.0	0.1
Metals (Method SW 7000 Series)				
Arsenic	11	NA	0.5	0.09
Lead	660	NA	0.5	0.06
SVOCs (Method SW 8270C)				
Benzo(a)pyrene	0.23	130	0.7	0.01
Benzo(a)anthracene	1.5	4.7	0.7	0.01
Benzo(b)fluoranthene	1.4	15	0.7	0.05
Benzo(k)fluoranthene	11.5	150	Not listed in AFCEE QAPP	0.03
Dibenzo(a,h)anthracene	0.21	4.5	0.7	0.02
Indeno(1,2,3-c,d)pyrene	4.2	41	0.7	0.01
VOCs (Method 8260B)				
Vinyl chloride	0.34	0.016	0.009	0.0011
TPH (Method IOWA DNR OA1)				
TPH-GRO	500	N/A	1	0.009
TPH (Method IOWA DNR OA2)				
TPH-DRO	500	N/A	10	0.82

Note: STARC - soil target concentration

N/A - not applicable

## 2.3 Field Sampling Scope

The scope of the RI/FS field work consists of:

- Drilling and installing approximately 30\* groundwater monitoring wells
- Drilling approximately 30 soil borings that are not converted into monitoring wells
- Collecting approximately 70 groundwater samples
- Collecting approximately 120 soil samples
- Collecting approximately 20 surface water samples
- Collecting approximately 20 sediment samples
- Surveying newly-installed monitoring wells

*\*Actual number may vary depending on the results of phased investigation approaches at sites AOC 001 and AOC 002*

The number, type, and locations of samples at each site are provided in the individual SSPs. A sample summary table is provided as **Table 2-3**.

## 2.4 Laboratory Analysis

CH2M HILL has contracted with Columbia Analytical Services (CAS), Redding, CA, to perform the sample analyses. CAS is experienced with AFCEE QAPP requirements and can satisfy the project DQOs.

The environmental samples will be analyzed for a suite of parameters including total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), target analyte list (TAL) metals, and polychlorinated biphenyls (PCBs). In addition, approximately four of the 16 sites will be sampled and analyzed for natural attenuation indicator parameters.

**Table 2-3** lists each RI/FS site, the sample matrix, the number of samples per matrix, and the sample analytical parameters.

**Table 2-3 Sample Summary \***  
**Richards-Gebaur AFB**

Site	Matrix	# Samples	Analytical Parameters					
			VOCs	SVOCs	TPH	Metals	PCBs	MNA
<b>AOC 001-Phase 1</b>	SE	9	9	9	9	9		
	SW	9	9	9	9	9		
<b>AOC 001-Phase 2"</b>	GW	6	6	6	6	6		6
	SO	6	6	6	6	6		
<b>AOC 002-Phase 1</b>	GW	1	1	1	1	1	1	
	SE	8	8	8	8	8	8	
	SW	3		3	3			
<b>AOC 002-Phase 2"</b>	GW	3	3	3	3	3	3	
	SO	4	4	4	4	4	4	
<b>AOC 003</b>	SW	3				3		
<b>AOC 010</b>	GW	1	1		1			
<b>CS 001</b>	GW	4	4		4			
	SO	13	13		13			
<b>CS 002</b>	GW	3	3		3	3		
	SO	3	3		3	3		
<b>CS 004</b>	GW	3	3	3	3	3		
	SO	3	3	3	3	3		
<b>FT 002</b>	GW	7	7	7	7	7	7	
	SO	13	13	13	13	13	13	
<b>SS 003</b>	GW	4	4	4	4	4		
	SO	3	3	3	3	3		
<b>SS 004</b>	GW	4	4	4	4	4		
	SO	3	3	3	3	3		
<b>SS 006</b>	GW	4	4	4	4	4		4
	SO	3	3	3	3	3		
<b>SS 008</b>	GW	1		1	1			
	SO	3			3	3		
<b>SS 009</b>	GW	3	3	3	3	3	3	3
	SO	3	3	3	3	3	3	

Table 2-3 Sample Summary \*

## Richards-Gebaur AFB

Site	Matrix	# Samples	Analytical Parameters					
			VOCs	SVOCs	TPH	Metals	PCBs	MNA
ST 005	GW	17	17	17	17	17		17
	SO	26	26	26	26	26		
ST 007	GW	3	3	3	3			
	SO	24	24	24	24			
XO 001	GW	6			6	6		
	SO	10			10	10		
	SE	6			6	6		
	SW	6			6	6		
TOTALS	GW	70	63	56	70	61	14	30
	SO	120	107	94	120	80	20	0
	SE	23	17	17	23	23	8	0
	SW	21	12	12	18	21	3	0

## Notes.

\* QA/QC samples are not included on this table

\*\* Collection of Phase 2 samples is contingent upon analytical results of Phase 1 investigation

GW = groundwater

SO = soil

SE = sediment

SW = surface water

VOCs = volatile organic compounds

SVOCs = semivolatile organic compounds

TPH = total petroleum hydrocarbons

PCBs = polychlorinated biphenyls

MNA = monitored natural attenuation parameters (dissolved oxygen, redox, alkalinity, pH, conductivity, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, Fe<sup>2+</sup>, and Cl<sup>-</sup>) MNA parameters will be restricted to four sites where organic compounds have been previously detected in groundwater

## 2.5 Data Validation

Upon receipt of the laboratory data, the electronic data will be validated according to the five measures of data quality defined in the project-specific QAPP – precision, accuracy, representativeness, completeness, and comparability (PARCC). Analytical data that do not meet the criteria will be flagged accordingly. Data validation will be conducted in accordance with Section 8.0 of the AFCEE QAPP (Version 3.0).

Related database management activities include database setup, input of laboratory electronic data, incorporation of data validation flags into the corresponding data records, and Quality Assurance/Quality Control (QA/QC) of the database, electronic data, and hardcopy data. All analytical data, including QC results and cross-reference tables, will be submitted in hard and electronic copies.

## 2.6 Data Evaluation

Analytical data will be generated for 16 individual sites and several other Base locations detailed in the Basewide RI/FS SOW. This data will supplement existing data at each of the RI/FS sites. The new data will be added to the existing data and updated data summary tables created for each site.

The resulting expanded site databases will be compared to ARARs and available risk-based cleanup criteria as set forth in the MDNR CALM Guidance. The ability of individual sites to satisfy regulatory closure criteria will be re-evaluated based upon the new data, and remaining data gaps or inconsistencies will be identified.

The RI/FS data will be compared to the criteria set forth in **Table 2-1** and **Table 2-2**. If the data for a given site do not exceed the corresponding CALM Scenario B action levels, then the site will be eligible for NFRAP-status consideration. However, a number of other factors need to be adequately addressed prior to recommending NFRAP decisions for sites. These include:

- adequate site characterization (including identifying groundwater hydraulic gradient and groundwater flow direction)
- documentation of removal actions
- post-excavation verification of contaminated soil removal
- regulatory approval of final site report

If the COC exceed applicable CALM numbers, then several actions may be taken, such as:

- proceeding to a CALM Tier 2 analysis
- conducting CALM Tier 3 risk assessment
- collecting additional site data to support Tier 2 or Tier 3 evaluations
- performing chemical fate and transport modeling
- evaluating natural attenuation processes
- undertaking site removal actions



Figure 2.1 illustrates the Decision Rules for the RI/FS.

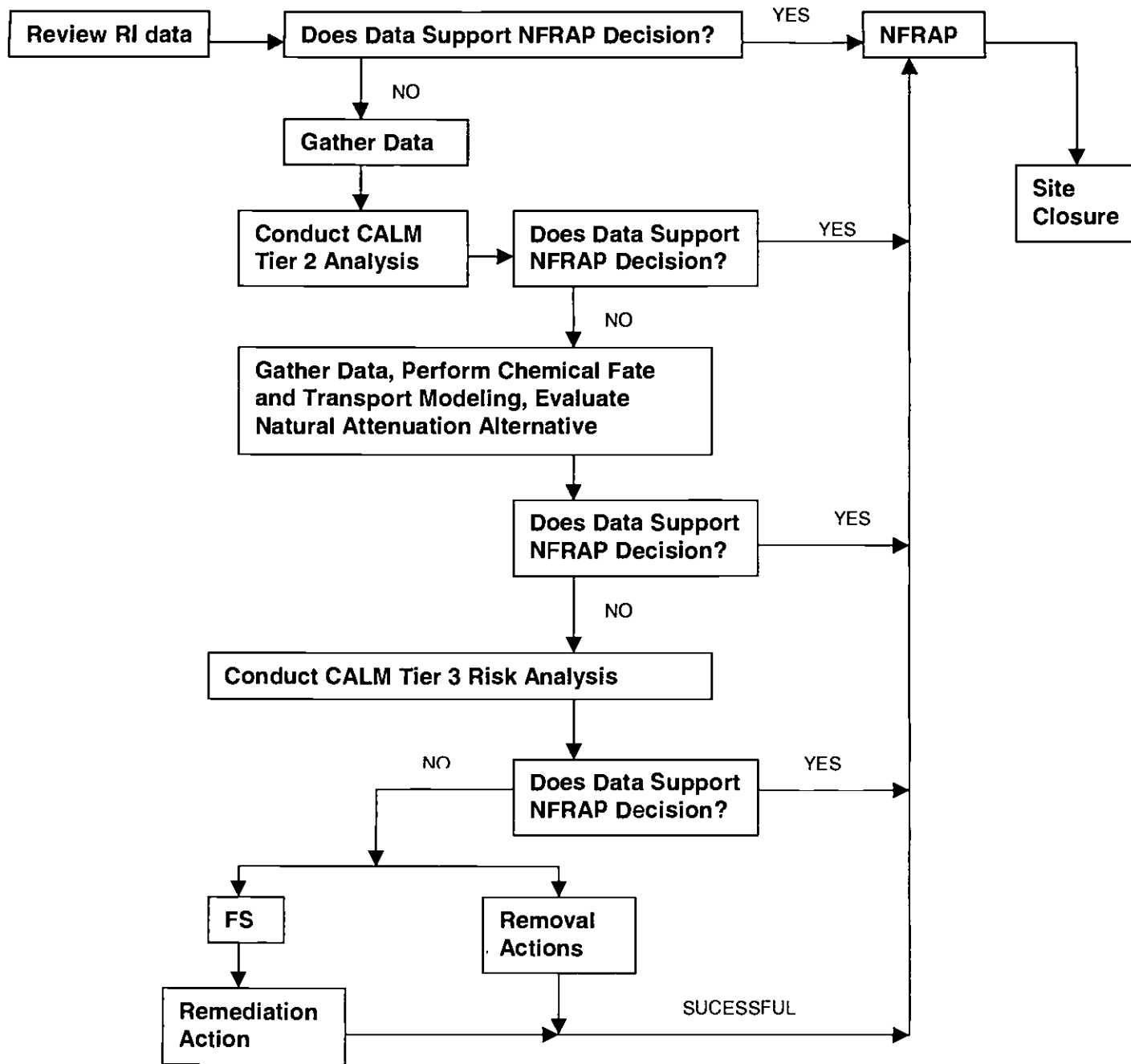


Figure 2.1 Decision Rule Flow Chart

Should none of the above options lead to NFRAP-status, then the site would be deferred to the Feasibility Study stage of the project.

## 2.7 Background Sampling

One of the objectives of the RI/FS is to develop representative basewide background concentrations of chemicals in soils and groundwater. This information is relevant to the evaluation of the capacity of the Base environment to support natural attenuation processes. Another objective of the investigation is to develop a better understanding of the basewide hydrogeology.

These goals will be mutually furthered by installing 14 monitoring wells that are not directly related to the individual RI/FS sites but are located in areas *between* the sites. The locations are deliberately chosen to provide information about previously uninvestigated areas of the Base. In this manner, representative soil and groundwater background concentrations can be established. Furthermore, gaps in the groundwater monitoring network can be eliminated allowing better extrapolation of groundwater contours across the Base as a whole. Figure 2.2 shows the current (pre-RI/FS) monitoring well locations together with the proposed locations of 14 basewide background monitoring wells.

In addition to the 14 locations described above, site-specific background samples will also be collected to help evaluate the occurrence of metals at several sites. These sites include the Central Drainage Area (AOC 001), the North Drainage Pond (AOC 002), the Firing Range (AOC 003), the North Burn Pit (FT 002), and the Belton Training Complex (XO 001).

The final location of background wells will be discussed with the regulators, and the locations will be subject to BCT approval. If necessary, off-base locations will be added. As with the other RI wells, the background wells will be installed between 6 and 18 feet into the upper bedrock unit to monitor the bedrock/overburden interface. Soil and groundwater samples will only be tested for naturally-occurring metals. Soil samples will be collected from the monitoring well borings at nominal depths of 1 foot and 5 feet below ground surface.

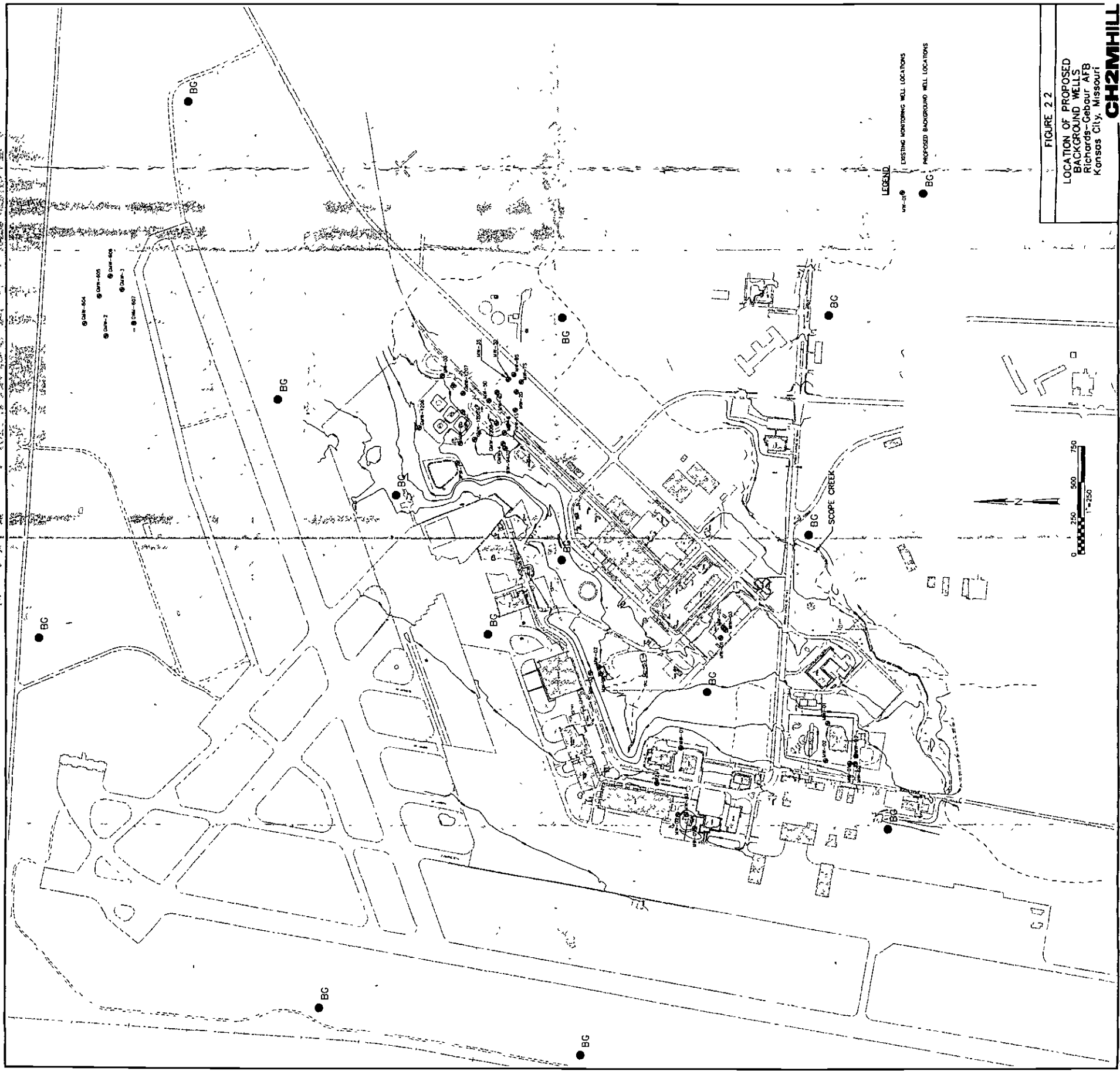


FIGURE 2.2  
LOCATION OF PROPOSED  
BACKGROUND WELLS  
Richards-Gebaur AFB  
Kansas City, Missouri

CH2MHILL

# TAB

*3. Project Organization*

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## 3.0 Project Organization

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The principal members of the proposed project team are identified in this section, together with a list of subcontractors.

### 3.1 CH2M HILL

The following key CH2M HILL roles and responsibilities have been identified for the RI/FS:

- Project Manager            Peter Barrett
- Senior Reviewer            Dan Price, R.G.
- Field Team Leader        Bob Trebble
- Site Safety Coordinator    Ning Li
- Project Chemist            Mark Cichy
- Field Team Members      Anne Bartin, Julie Mottin

Peter Barrett will assume overall responsibility for project deliverables, budget and schedule. He is the principal point of contact for CH2M HILL. Dan Price, a Missouri-registered geologist, will perform senior review of the project and major deliverables. Bob Trebble will be responsible for coordinating and managing the RI/FS field work. Ning Li will serve as Site Safety Coordinator, ensuring that all onsite work is conducted in conformance with applicable Occupational Safety and Health Act (OSHA) regulations. Data validation and database management, including ERPIMS, will be performed by Anne Bartin and Mark Cichy. Julie Mottin will support the field effort and will assist in creating a GIS database for Richards-Gebaur AFB.

The identities and roles of other project participants, including Air Force and regulatory participants, are provided in Section 5 of the QPWP.

### 3.2 Subcontractors

Three subcontractors have been selected to assist in the fieldwork and laboratory tasks.

- Drilling Services            Layne-Western, Kansas City, MO
- Laboratory                Columbia Analytical Services, Redding, CA
- Waste Management        GSI, Kansas City, KS
- Regulatory Advisor        Van Breusegen & Associates (Dale Cira), St. Louis, MO

In addition, CH2M HILL will use four staff from Wendy Lopez and Associates (WLA), Dallas, TX. WLA is affiliated with CH2M HILL through the federal Mentor-Protégé program. A two-person survey team will be tasked with surveying the new monitoring well and soil boring locations. In addition, one WLA staff member will assist in electronic data deliverable management, and another will help with surface water, sediment, and groundwater sampling.

# TAB

*4. Field Methodologies*

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## 4.0 Field Methodologies

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The following field operations will be conducted during the Basewide RI/FS at Richards-Gebaur AFB:

- drilling, continuous sampling, and geologic logging of soil borings
- construction and development of monitoring wells
- abandonment of damaged or dry monitoring wells
- abandonment of soil borings
- decontamination of personnel and equipment
- management of investigation-derived waste (IDW)
- surveying of sampling and monitoring well locations

General procedures for each of the field operations listed above are described in this section. Environmental sample collection is detailed in Section 5 of the FSP. Unless otherwise specified in the SSPs (provided in Appendix A), the procedures described in this section will be followed at each of the 16 sites encompassed by the Basewide RI/FS. In addition, CH2M HILL standard operating procedures (SOPs) for routine field tasks are provided as Appendix B to the FSP.

### 4.1 Site Reconnaissance and Preparation

Before beginning field work at Richards-Gebaur AFB, underground utilities will be located in all areas designated for drilling or other intrusive sampling. Utility locations will be determined using existing utility maps, and, where necessary, verified in the field using a hand-held magnetometer or utility probe. Mr. Dave Malecki, the provisional Base POC and Airport Manager at Richards-Gebaur Municipal Airport, will help locate buried utility lines at each site prior to beginning any subsurface drilling or sampling.

In addition to utilities, site access will be evaluated prior to any field activity. Because two sites, SS 003 and CS 002, are located on property owned by the U.S. Marine Corps, Mr. John Hurd will be contacted for access to these areas. Access to the Belton Training Complex will be coordinated both with the Air Force and the property owner controlling the right-of-way to the site. Care will be taken to ensure that the gates to the site are locked at all times other than when field crews enter and leave the site.

An onsite field office will be located at 15790 Elmwood Avenue. The field office will provide a communications center for onsite field crews and offsite project members; a temporary staging area for environmental samples prior to shipment; and a storage area for field equipment and supplies.

Before beginning site investigations, a decontamination area for the drilling rig and drilling equipment will be designated. The location of the decontamination area will be based on the nature and extent of COC, site topography, and prevailing wind direction. Decontamination areas will be lined with heavy gauge plastic sheeting, designed with a collection system to capture decontamination waters and allow eventual placement into 55-

gallon drums. Smaller decontamination areas for personnel and portable equipment will be established as necessary.

During the RI, a central staging area for drums and flexible containers of investigation-derived waste (IDW) will be designated. The IDW will remain in the staging area until the IDW disposal contractor characterizes the material and arranges for pick-up, transportation and offsite disposal of the waste at an appropriately permitted disposal facility. Management of IDW is discussed in detail in Section 4.8 of the FSP.

Each work site or sampling location will be returned to its original condition whenever possible. Efforts will be made to minimize impacts to work sites and sampling locations, particularly those in or near sensitive environments. Following the completion of work at a site, all drums, trash, and other waste will be removed to the designated IDW staging area. Decontamination areas will be dismantled as soon as possible after completing a site investigation.

## 4.2 Geologic Standards for Field Logging

Over 60 soil and groundwater monitoring well borings will be drilled during the Basewide RI/FS at Richards-Gebaur AFB. A key component of the investigation is accurately describing the soil (unconsolidated) and bedrock (consolidated) conditions at each site, particularly the uppermost water-bearing zone. To accomplish this, continuous soil samples will be collected from each boring to give the field geologist the ability to construct detailed field logs of the subsurface conditions at each boring location. The following sections describe the general methods that will be used to describe the geological conditions at Richards-Gebaur AFB. Further details are provided in the corresponding SOP

### 4.2.1 Unconsolidated Materials

The lithologic descriptions for unconsolidated materials (soils [engineering usage] or deposits) will use the name of the predominant particle size (e.g., silt, fine sand, etc.). The dimensions of the predominant and secondary sizes will be recorded using the metric system. The grain size and name of the deposit will be accompanied by the predominant mineral content, accessory minerals, color, particle angularity, and any other characteristics. The clastic deposit descriptions will include, as a supplement, symbols of the Unified Soil Classification System. Color descriptions will be designated by the Munsell Color System.

### 4.2.2 Consolidated Materials

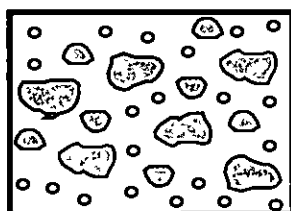
The lithologic descriptions for consolidated materials (igneous, metamorphic, and sedimentary rocks) will follow the standard professional nomenclature (cf. Tennissen, A.C., 1983, *Nature of Earth Materials*, 2nd Edition, p. 204-348), with special attention given to fractures, vugs, solution cavities and their fillings or coatings, and any other characteristics affecting permeability. Colors will be designated using the Munsell Color System.

The sedimentary, igneous, and metamorphic rocks and deposits will be represented graphically by the patterns shown in **Figure 4.1**. Columnar sections, well and boring logs, well construction diagrams, cross sections, and three-dimensional (3-D) diagrams will use these patterns. Supplementary patterns will follow Swanson, R. G., 1981, *Sample Examination Manual*, American Association of Petroleum Geologists, p IV-41 and 43. Geologic structure symbols will follow *American Geological Institute Data Sheets*, 3d Edition, 1989, sheets 3.1 through 3.8.

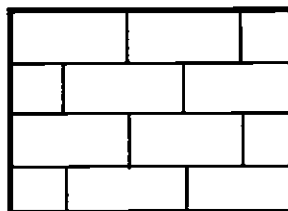


Figure 4.1  
Lithologic Patterns for Illustration

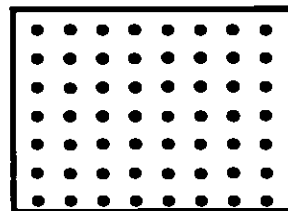
Sediments and Sedimentary Rocks



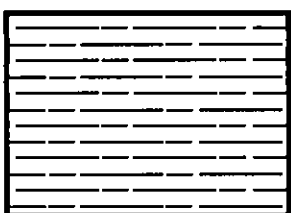
Gravel and Conglomerate



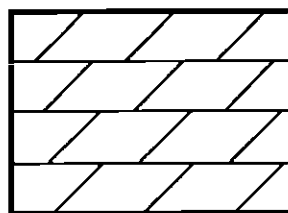
Limestone



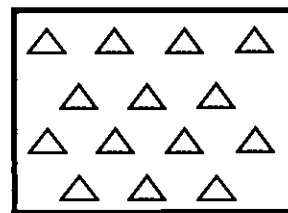
Sand and Sandstone



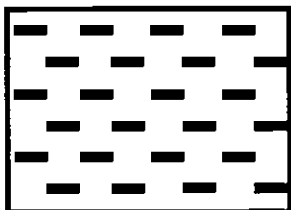
Silt and Siltstone



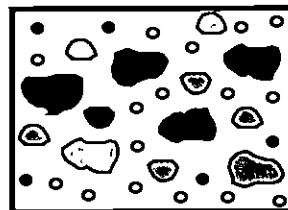
Dolomite



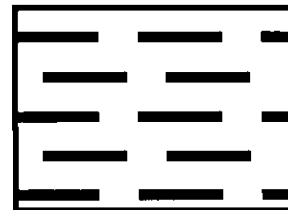
Chert



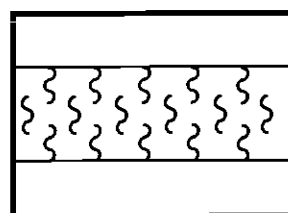
Clay



Glacial Till

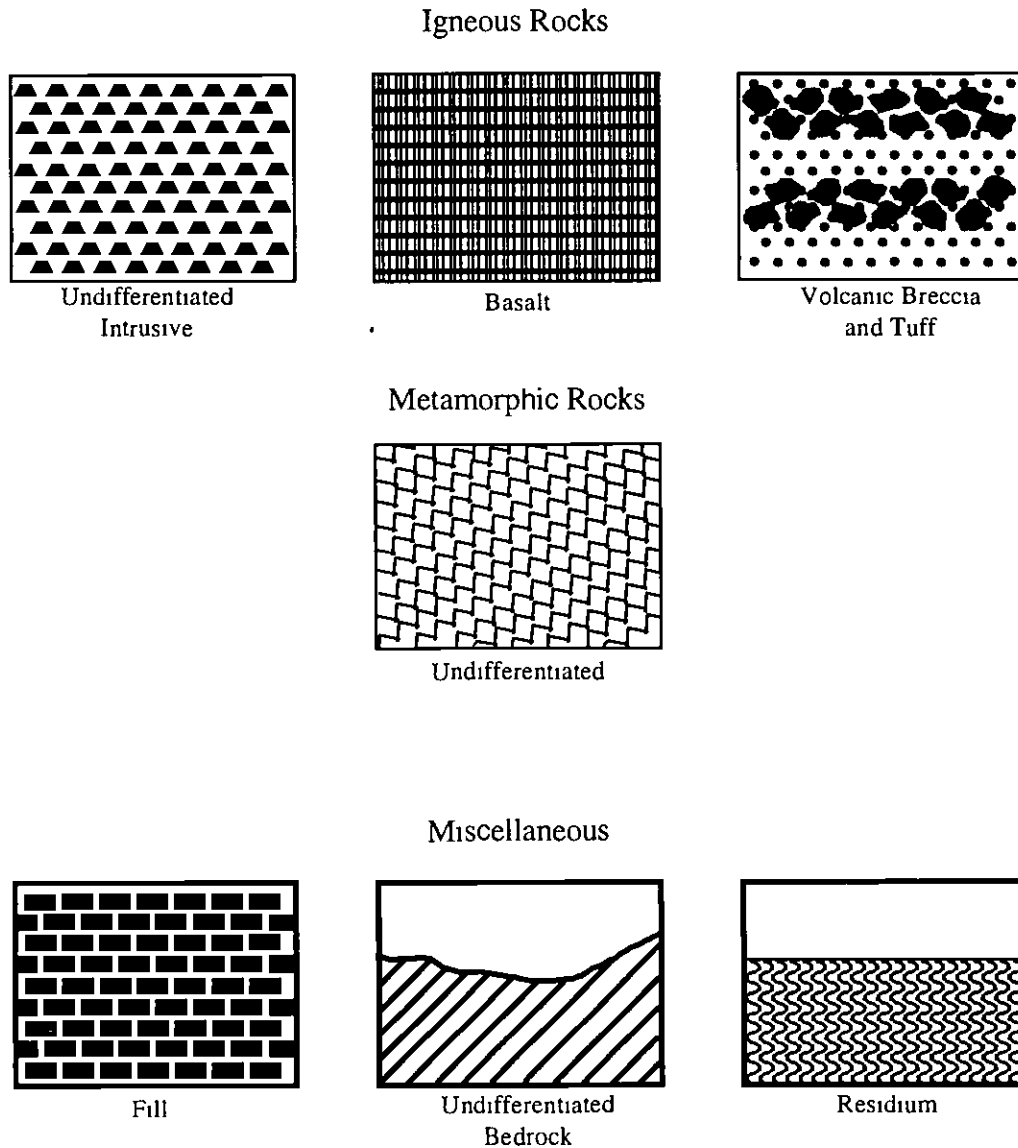


Shale



Loess

**Figure 4.1 (Continued)**  
**Lithologic Patterns for Illustration**



### 4.2.3 Mapping

Scales for maps, cross sections, or 3-D diagrams will be selected in accordance with the geologic and hydrologic complexity of the area and the purposes of the illustrations.

For orientation, the cross-sections will show the Northern end on the viewer's right. If the line of cross section is predominantly East-West, the eastern end is on the right. Maps will be oriented with North toward the top, unless the shape of the area dictates otherwise. In all cases, orientation will be indicated with a North arrow.

## 4.3 Borehole Drilling and Abandonment

Further details on drilling techniques and methodologies can be found in the accompanying SOP, *Soil Boring Drilling and Abandonment*, provided in Appendix B.

### 4.3.1 Borehole Drilling

All drilling activities will conform to State of Missouri regulations and will be supervised by a state licensed geologist or state licensed engineer. The contractor will obtain and pay for all permits, applications, and other documents required by the State of Missouri. The drilling subcontractor must hold a MDNR Well Drillers and Pump Installers Permit, issued by MDNR's Division of Geology and Land Survey.

The location of all borings will be coordinated, in writing, with the Base Realignment and Closure Cleanup Team (BCT) before drilling commences. When drilling boreholes through more than one water-bearing zone or aquifer, the contractor will take measures to prevent cross-connection or cross-contamination of the zones or aquifers.

The drill rig will be cleaned and decontaminated in accordance with the attached SOP. The drill rig will not leak any fluids that may enter the borehole or contaminate equipment placed in the hole. The use of rags or absorbent materials to absorb leaking fluids is unacceptable.

Drilling will be done using hollow stem augers. Drilling fluids are not anticipated. If water is used, the contractor will provide chemical analyses of the water for AFCEE approval. Only water from a pre-approved source will be used as a drilling fluid and the water quality will be monitored daily for suspected analytes of concern. If drilling mud is used, it will consist of 100 percent sodium bentonite and will be pre-approved by AFCEE and MDNR. The prime contractor will provide AFCEE with the chemical analyses of any drilling mud additive or substitute proposed for use prior to the start of drilling. The additives or substitutes will be analyzed for all analytes of concern at the site. The analyses will be delivered to AFCEE for written approval prior to drilling system mobilization. Mud or other additives will only be used as a last resort.

A log of drilling activities will be kept in a bound field notebook. Information in the log book will include location, time on site, personnel and equipment present, down time, materials used, samples collected, measurements taken, and any other observations or information that would be necessary to reconstruct field activities at a later date. At the end of each day of drilling the drilling supervisor will complete a Daily Drilling Log. Field documentation is described in more detail in Section 9.0.

The contractor will dispose of all trash, waste grout, cuttings, and drilling fluids as described in Section 4.8

### 4.3.2 Borehole Abandonment

Boreholes that are not converted to monitoring wells will be abandoned in accordance with applicable State of Missouri requirements. Specific abandonment procedures are outlined in the SOP, *Soil Boring Drilling and Abandonment*, provided in Appendix B. A bentonite-cement slurry will be placed from the bottom to the top of the hole using a tremie pipe.

The abandoned boreholes will be checked 24 to 48 hours after abandonment to ensure that curing occurred properly. If settling has occurred, a sufficient amount of mud/solid bentonite will be added to fill the hole to the ground surface. The curing checks and any addition of mud/solid bentonite will be recorded in the field log.

## 4.4 Monitoring Well Installation

Monitoring well installation and development procedures are described in the SOP, *Monitoring Well Installation and Development*, provided in Appendix B.

Monitoring well installation activities will conform to State of Missouri regulations. The wells will be constructed by a drilling subcontractor that holds a Missouri Well Drillers and Pump Installers Permit, issued by the MDNR Division of Geology and Land Survey.

A State of Missouri Registered Geologist or equivalent will supervise monitoring well installation. When there is a possibility that light non-aqueous phase liquids (LNAPLs) may exist, monitoring wells will be screened across the water table. If the presence of dense non-aqueous phase liquid (DNAPL) is suspected, monitoring wells will be screened at the contact between the unconsolidated overburden and the underlying bedrock to increase the likelihood of detecting residual DNAPL.

In the event that a monitoring well boring appears dry, the boring will be left open a minimum of 48 hours to allow the boring to make water. If, after 48 hours has elapsed, the well boring remains dry, the boring will be abandoned in accordance with the procedures described above in Section 4.3.2.

### 4.4.1 Drilling Requirements

All drilling and well installations will conform to Missouri Well Construction Rules, RSMo Sections 256.600 to 256.640. The contractor will obtain and pay for all permits, applications, and other documents required by state and local authorities. The location of all borings will be coordinated in writing with the BCT before drilling commences.

The rig will be cleaned and decontaminated according to the guidelines described in Section 4.7. The rig will not leak any fluids that may enter the borehole or contaminate equipment that is placed in the hole. The use of rags or absorbent materials to absorb leaking fluids is unacceptable. Acceptable drilling fluids are air, water, and mud.

Drilling lubricants will not introduce or mask contaminants at the site. The contractor will provide, to AFCEE, chemical analyses of all lubricants proposed for downhole use prior to the start of drilling. Chemical detection limits will be equivalent to those used in analyzing the project ground-water samples. Lubricants with constituents that are toxic or that increase, decrease, or mask the target chemical species of the investigation will not be permitted. The contractor will provide the analysis results prior to drilling mobilization.

The contractor will dispose of all trash, waste grout, cuttings, and drilling fluids. When installing wells through more than one water-bearing zone or aquifer, the contractor will take measures to prevent cross-connection or cross-contamination of the zones or aquifers.

### 4.4.2 Borehole Requirements

Borehole diameters will be at least four inches larger than the outside diameter of the casing and well screen. In the case of a hollow stem auger, the inside diameter of the auger will be at least four inches larger than the outside diameter of the casing and well screen.

A completed monitoring well will be straight and plumb. The monitoring well will be sufficiently straight to allow passage of pumps or sampling devices. The monitoring well will be plumb within 1 degree of vertical where the water level is greater than 30 feet below land surface unless otherwise approved by AFCEE. AFCEE may waive a plumbness

requirement. Any request for a waiver from straightness or plumbness specifications will be made, in writing, to AFCEE in advance of mobilization for drilling. The contractor will use a single-shot declination tool to demonstrate plumbness. Monitoring wells not meeting straightness or plumbness specifications will be redrilled and/or reconstructed.

Samples will be monitored with an organic vapor monitor (e.g., PID, OVA). The samples will be handled in such a way as to minimize the loss of volatiles. These procedures are described in Section 6.0. Cuttings will be examined for their hazardous characteristics. Materials that are suspected to be hazardous because of abnormal color, odor, or organic vapor monitor readings will be containerized in conformance with Resource Conservation and Recovery Act (RCRA) regulations and state and local requirements. Rock cores will be stored in standard core boxes, and missing sections of core will be replaced with spacers.

A standard penetration test will be performed each time a split spoon sample is taken. The test will be performed in accordance with ASTM D-1586.

#### **4.4.3 Casing Requirements**

Schedule 40 PVC casing will be used to construct groundwater monitoring wells. The casing will be flush-threaded and nominally 10 feet long. The casing will be straight and plumb within the tolerance stated for the borehole, and the driller will cut a notch in the top of the casing to be used as a measuring point for water levels.

#### **4.4.4 Well Screen Requirements**

Groundwater monitoring wells will be constructed to monitor the interface between the overburden soils and the uppermost bedrock unit. The well screens will be factory slotted/wrapped and sized to prevent 90 percent of the filter pack from entering the well.

#### **4.4.5 Annular Space Requirements**

The annular space between the well and the borehole wall will be filled with a filter pack, a bentonite seal, and casing grout. Additional details are provided in the attached SOP.

#### **4.4.6 Filter Pack Requirements**

The filter pack will consist of silica sand or gravel and will extend from the bottom of the hole to at least two feet above the top of the well screen. The top of the filter pack will be sounded to verify its depth during placement. Additional filter pack will be placed as required to return the level of the pack to two feet above the screen.

The filter pack material will be clean, inert, and well-rounded and will contain less than two percent flat particles. The sand or gravel will be certified free of contaminants by vendor or contractor.

The filter pack will have a grain size distribution and uniformity coefficient compatible with the formation materials and the well screen. If necessary, the filter pack will be placed using a bottom-discharge tremie pipe of at least 1-1/2 inches in diameter. If used, the tremie pipe will be lifted from the bottom of the hole at the same rate the filter pack is set. If the borehole recharges slowly after drilling is complete, filter pack materials may be poured from ground surface directly into the annular space around the well casing. The contractor will record the volume of the filter pack placed in the well.

#### 4.4.7 Bentonite Seal Requirements

The bentonite seal will consist of at least three feet of bentonite between the filter pack and the casing grout. The bentonite will be hydrated during placement. If necessary, bentonite will be inserted around the well casing using a tremie pipe. If water recharges slowly into the borehole after drilling is complete, bentonite may be poured from ground surface directly into the annular space around the well casing. Bentonite materials will comply with specifications described in Missouri Well Construction Rules.

#### 4.4.8 Casing Grout Requirements

The casing grout will extend from the top of the bentonite seal to ground surface. The grout mixture will comply with specifications described in the Missouri Well Construction Rules. The grout will be delivered to the annular space using a tremie pipe or other method that complies with the Missouri Well Construction Rules.

#### 4.4.9 Surface Completion Requirements

For flush-mounted completions, the casing will be cut about three inches below the land surface. A watertight casing cap will be used to prevent surface water from entering the well. The top of the casing will be at least one foot above the bottom of the box. The valve box lid will be centered in a three-foot diameter, four-inch thick concrete pad that slopes away from the box at 1/4 inch per foot. The identity of the well will be permanently marked on the valve box lid and the casing cap. Where heavy traffic may pass over the well or for other reasons, the concrete pad and valve box/lid assembly will be constructed to meet the strength requirements of surrounding surfaces.

When aboveground surface completion is used, the well casing will extend two to three feet above land surface. The extended above-ground casing will be protected with a steel protective casing that is placed over the casing and cap and seated in a 3-foot by 3-foot by 4-inch concrete surface pad. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole will be placed in the well casing, or a ventilated well cap will be used.

All wells will be secured as soon as possible after drilling. Corrosion-resistant locks will be used for both flush and aboveground surface completions. The locks will have identical keys or be keyed for opening with one master key.

#### 4.4.10 Monitoring Well Completion Diagrams

A completion diagram will be submitted for each monitoring well installed.

### 4.5 Monitoring Well Development

Monitoring well development activities will be performed in accordance with the SOP, *Monitoring Well Installation and Development*, provided in Appendix B.

Newly installed monitoring wells will be developed no sooner than 24 hours after installation to allow for grout curing. Wells will be developed using surge blocks and bailers or pumps until the well water is free of suspended sediment. Development water characteristics will be described and noted in the field log book. Well development equipment will be decontaminated according to the specifications of Section 4.7.

## 4.6 Surveying

All surveying locations of field activities will be measured by a certified land surveyor as the distance in feet from a reference location that is tied to the state plane system. The surveys will be third order (cf. Urquhart, L.C., 1962 *Civil Engineering Handbook*, 4th Edition, p. 96 and 97). An XY-coordinate system will be used to identify locations. The X-coordinate will be the East-West axis; the Y-coordinate will be the North-South axis. The reference location is the origin. All surveyed locations will be reported using the state plane coordinate system. The surveyed control information for all data collection points will be recorded and displayed in a table. The table will give the X and Y coordinates in state plane coordinate values, the ground elevation, and the measuring point elevation if the location is a groundwater monitoring well. The elevation of all newly installed wells will be surveyed at the water level measuring point (notch) on the riser pipe. The elevation of the ground surface will be included in the survey.

Global Positioning System (GPS) coordinates will be recorded for each surface water and sediment sample collected during the Basewide RI. This will be done after all surface water and sediment samples have been collected. Therefore, immediately after sample collection, the field team will designate sediment and surface water sampling locations with stakes or other semi-permanent marking.

The following are minimum standards of accuracy for the work:

1. Horizontal traverses shall have a minimum ratio of closure of 1:20,000. The ratio of closure shall be calculated after angles are balanced and before coordinates are adjusted. All traverses shall have angular closures not to exceed 45 seconds times the square root of the number of courses in the traverse.
2. All level runs shall have closures of 0.03 foot times the square root of the number of miles on the level run. All leveling shall be checked by running closed loops, by taking readings on previously established turning points or benchmarks, or by some other procedure acceptable to the Air Force. All benchmarks shall be turned through and become part of the level loop.
3. Spot elevations shall be accurate to within  $\pm 0.01$  ft. on hard surfaces and  $\pm 0.10$  ft on other surfaces.
4. Surface water points shall be read to  $\pm 1.0$  ft. of their true horizontal location. Other physical features shall be shown to within  $\pm 0.2$  ft. of their true horizontal location.
5. Topographic and cultural features shall be tied in a manner to enable the calculation of coordinates of each feature shown on the site map. The type of feature tied shall be identified in the field log book.

## 4.7 Equipment Decontamination

Equipment decontamination activities will be conducted in accordance with the SOPs *Decontamination of Drilling Rigs and Equipment* and *Decontamination of Field Personnel and Equipment*, provided in Appendix B.

All equipment that may directly or indirectly contact samples will be decontaminated in a designated decontamination area. This includes casing, drill bits, auger flights, the portions of drill rigs that stand above boreholes, sampling devices, and instruments, such as slugs and sounders. In addition, the contractor will take care to prevent the sample from coming

into contact with potentially contaminating substances, such as tape, oil, engine exhaust, corroded surfaces, and dirt.

The following procedure will be used to decontaminate large pieces of equipment, such as casings, auger flights, pipe and rods, and those portions of the drill rig that may stand directly over a boring or well location or that come into contact with casing, auger flights, pipe, or rods. The external surfaces of equipment will be washed with high-pressure hot water and Alconox, or equivalent laboratory-grade detergent, and if necessary, scrubbed until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., have been removed. The equipment will then be rinsed with potable water. The inside surfaces of well casing, drill rods, and auger flights will also be washed as described.

The following procedure will be used to decontaminate sampling and drilling devices, such as split spoons, bailers, and augers that can be hand-manipulated. For sampling and smaller drilling devices, the equipment will be scrubbed with a solution of potable water and Alconox, or equivalent laboratory-grade detergent. The equipment will then be rinsed with copious quantities of potable water followed by a ASTM Type II Reagent Water. High-pressure liquid chromatograph-grade water and distilled water purchased in stores are not acceptable substitutes for ASTM Type II Reagent-Grade Water. If equipment has come in contact with oil or grease, it will be rinsed with pesticide-grade methanol followed by a second rinse with pesticide-grade hexane. The decontaminated equipment will be left to dry on a clean surface or rack. If the sampling device will not be used immediately after being decontaminated, it will be wrapped in oil-free aluminum foil, or placed it in a closed stainless steel, glass, or Teflon® container

Reagent-Grade II Water, methanol, and hexane will be purchased, stored, and dispensed only in glass, stainless steel, or Teflon® containers. These containers will have Teflon® caps or cap liners. It is the contractor's responsibility to assure these materials remain free of contaminants. If any question of purity exists, new materials will be used.

## 4.8 Waste Handling

Waste handling procedures will be consistent with the SOP, *Disposal of Waste Fluids and Solids*, provided in Appendix B. Waste handling will be dealt with on a site-by-site basis. Waste may be classified as non-investigation-derived waste or investigation-derived waste (IDW).

Non-investigation-derived waste, such as litter and household garbage, will be collected on an as-needed basis to maintain each site in a clean and orderly manner. This waste will be containerized and transported to the designated sanitary landfill or collection bin. Acceptable containers will be sealed boxes or plastic garbage bags.

IDW will be properly containerized and temporarily stored at a central location at Richards-Gebaur AFB. Depending on the constituents of concern, fencing or other special marking may be required. The number of containers will be estimated on an as-needed basis. Acceptable containers will be sealed U.S. Department of Transportation (DOT)-approved steel 55-gallon drums, flexible 1-cubic yard containers, or small dumping bins with lids. The containers will be transported in such a manner to prevent spillage or particulate loss to the atmosphere. To facilitate handling, the containers will be no more than half full when moved.

IDW will be segregated at the site according to matrix (solid or liquid) and derivation (drill cuttings, drilling fluid, decontamination fluids, and purged groundwater). Each container will



be properly labeled with site identification, sampling point, depth, matrix, constituents of concern, and other pertinent information for handling. IDW will be sampled for waste classification by the IDW subcontractor prior to offsite transportation and disposal. Offsite transport and disposal will be performed by a commercial firm, also under subcontract. Based on the results of the IDW characterization, the waste materials will be disposed in accordance with applicable solid waste, hazardous waste, and water quality regulations.

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*5. Environmental Sampling*

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## 5.0 Environmental Sampling

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This section outlines procedures that will be followed during the collection, handling, and transport of environmental samples during the Basewide RI/FS at Richards-Gebaur AFB.

The construction material of the sampling devices (e.g., plastic, PVC, metal) discussed below will be appropriate for the contaminant of concern and will not interfere with the chemical analyses being performed.

All purging and sampling equipment will be decontaminated according to the specifications in Section 4.7 prior to any sampling activities and will be protected from contamination until ready for use

### 5.1 Groundwater Sampling

During the Basewide RI/FS at Richards-Gebaur AFB, groundwater samples will be collected from new and existing monitoring wells. Groundwater samples will not be collected from direct-push boreholes or temporary piezometers.

When numerous monitoring wells are to be sampled in succession, those wells expected to have low levels of contamination or no contamination will be sampled prior to those wells expected to have higher levels of contamination. This practice will help reduce the potential for cross contamination between wells. All sampling activities will be recorded in the field log book. Additionally, all sampling data will be recorded on a well sampling form. Field forms and documentation are discussed in Section 9.0.

Before ground-water sampling begins, wells will be inspected for signs of tampering or other damage. If tampering is suspected, (i.e., casing is damaged, lock or cap is missing) this will be recorded in the field log book and on the well sampling form, and reported to the Field Team Leader. Wells that appear to have been tampered with will not be sampled until the Field Team Leader has discussed the matter with the Project Manager.

Before the start of sampling activities, plastic sheeting will be placed on the ground surrounding the well. The plastic sheeting will be used to provide a clean working area around the well head, and prevent any soil contaminants from contacting sampling equipment. Water in the protective casing or in the vaults around the well casing will be removed prior to venting and purging.

Purge pump intakes will be equipped with a positive foot check valve to prevent purged water from flowing back into the well. Purging and sampling will be performed in a manner that minimizes aeration in the well bore and the agitation of sediments in the well and formation. Equipment will not be allowed to free-fall into a well.

The following information will be recorded each time a well is purged and sampled (the information will be also be encoded in ERPIMS files):

- Depth-to-water before and after purging
- well bore volume calculation
- sounded total depth of the monitoring well

- the condition of each well, including visual (mirror) survey
- the thickness of any nonaqueous layer
- field parameters pH, temperature, electrical conductivity (EC), dissolved oxygen (DO)

## 5.2 Water Level Measurement

Water level measurements will be made by following the SOP, *Water Level Measurements*, provided in Appendix B.

An interface probe will be used if a nonconductive floating product layer is suspected in the well. The interface probe will be used to determine the presence of floating product, if any, prior to measurement of the groundwater level. The ground-water level will then be measured to the nearest 0.01-foot using an electric water level indicator. Water levels will be measured from the notch located at the top of the well casing and recorded on the well sampling form. If well casings are not notched, measurements will be taken from the north edge of the well casing, and a notch will be made using a decontaminated metal file.

Following water level measurement, the total depth of the well from the top of the casing will be determined using a weighted tape or electric sounder and recorded on the well sampling form. The water level depth will then be subtracted from the total depth of the well to determine the height of the water column present in the well casing. All water level and total depth measuring devices will be routinely checked with a tape measure to ensure measurements are accurate.

## 5.3 Purging Prior to Sampling

Purging of monitoring wells is performed to evacuate water that has been stagnant in the well and may not be representative of the aquifer. Purging will be accomplished using a Teflon® bailer or a pump. All purging activities, with the exception of micropurging, will be performed in accordance with the SOP, *Groundwater Sampling from Monitoring Wells*, provided in Appendix B.

Except as noted below, at least three well volumes will be removed from the well before it is sampled. The well bore volume is defined as the volume of submerged casing and screen. One well volume can be calculated using the following equation (reference: Ohio EPA Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring Programs, June 1993).

$$V = H \times F$$

Where: V = one well volume

H = the difference between the depth of well and depth to water (ft)

F = factor for volume (gallons) of one foot section of casing (from **Table 5.1**)

**Table 5.1 Volume of Water in One-Foot Section of Well Casing**

Diameter of Casing (Inches)	F Factor (gallons)
1.5	0.09
2	0.16
3	0.37
4	0.65
6	1.47

F can also be calculated from the formula:

$$F = \pi (D/2)^2 \times 7.48 \text{ gal/ft}^3$$

Where: D = the inside diameter of the well casing (feet).

Wells with yields too low to produce three well volumes before the well goes dry will be purged to dryness.

The temperature, pH, electrical conductivity (EC), and turbidity will be measured and recorded on the well sampling form after removing each well volume during purging. Water removed from the well during purging will be containerized. Detailed information concerning IDW management is presented in Section 4.8.

For wells where VOCs are of concern, or for wells that are known to recharge slowly, Micropurge techniques may be used. Micropurge, an AFCEE-approved procedure, is a low flow-rate monitoring well purging and sampling method that induces laminar (non turbulent) flow in the immediate vicinity of the sampling pump intake, thus drawing groundwater directly from the sampled aquifer, horizontally through the well screen, and into the sampling device. Low-flow pumping rates associated with the micropurge technique are in the approximate range of 0.2 to 2.0 liters/min. These low flow rates minimize disturbance in the screened aquifer, resulting in: (1) minimal production of artificial turbidity and oxidation; (2) minimal mixing of chemically distinct zones; (3) minimal loss of volatile organic compounds; and (4) collection of representative samples while minimizing purge volume. Micropurging procedures are outlined in the SOP, *Low-Flow Groundwater Sampling from Monitoring Wells*, provided in Appendix B.

## 5.4 Sample Collection

Groundwater sampling from monitoring wells will be performed in accordance with the SOP, *Groundwater Sampling from Monitoring Wells*, provided in Appendix B.

Samples will not be taken within 24 hours of monitoring well development. Except as noted below, at least three well volumes will be removed from the well before it is sampled.

The sample may be collected after three well volumes have been removed and the temperature, pH, EC and, turbidity have stabilized. Stabilization will be defined as follows: temperature  $\pm 1^\circ\text{C}$ , pH  $\pm 0.1$  units, EC  $\pm 5$  percent, and turbidity  $\pm 10$  NTU for at least 30 minutes. If these parameters do not stabilize, the sample will be collected after six well volumes have been removed, and the anomalous parameters will be brought to the Field

Team Leader's attention. Field equipment will be calibrated in accordance with the AFCEE QAPP, Section 6.0 and in Section 8.2 of the FSP.

Samples will be collected after the water level has recovered to 80 percent of its static level or 16 hours after completion of purging, whichever occurs first. If a monitoring well is bailed or pumped dry before three well volumes can be obtained, the sample will be collected when a sufficient volume of water has accumulated in the well.

For wells suspected of containing VOCs, Micropurge sampling techniques may be used. Micropurge sampling will use small positive-displacement pumps (e.g., bladder pumps). Samples to be analyzed for volatile or gaseous constituents will not be withdrawn with pumps or at flows that degas the samples. Water-quality indicators will be monitored during micropurge (turbidity, dissolved oxygen, specific conductance, temperature, etc.).

Before collecting ground-water samples, the sampler will don clean, phthalate-free protective gloves. Samples being analyzed for VOCs will be collected first using a bottom-filling Teflon® or PVC bailer. Samples to be analyzed for volatile or gaseous constituents will not be withdrawn with pumps that exert a vacuum on the sample (e.g., centrifugal and peristaltic). Disposable nylon rope will be used to lower and retrieve the bailers. A new length of nylon rope will be used for each well, and the rope will be disposed of following the sampling activities. Each bailer will be equipped with a dedicated stainless steel or Teflon® coated leader so that the nylon rope will not contact the water in the well.

If DNAPL is suspected, a bailer will be lowered to the bottom of the well before purging, retrieved, and observed for the presence of DNAPL. The preservative hydrochloric acid will be added to the VOC sample bottle before introducing the sample water. The sample will be collected from the bailer using a slow, controlled pour down the side of a tilted sample vial to minimize volatilization. The sample vial will be filled until a meniscus is visible and immediately sealed. When the bottle is capped, it will be inverted and gently tapped to ensure no air bubbles are present in the vial. If, after the initial filling bubbles are present, the vials will be discarded and the VOC sampling effort will be repeated. Refilling of vials will result in loss of preservatives. After the containers are sealed, sample degassing may cause bubbles to form. These bubbles will be left in the container. These samples will never be composited, homogenized, or filtered.

Following collection of VOC samples, remaining water samples will be collected in the following order: natural attenuation indicator parameters (nitrate, sulfate, methane/ethene/ethane), TPH, SVOCs (including polynuclear aromatic hydrocarbons - PAHs); PCBs, and metals.

The pH of preserved samples will be checked in the field by pouring a small amount of the water sample onto pH paper. The paper will not touch the sample inside the container. Do not check the pH of acidified VOC samples. The preservation checks will be documented in the chain-of-custody forms. One preserved VOC sample per day per sampling crew will be checked with pH paper. The sole purpose of this sample is to check the pH of VOC samples, it will not be submitted for analysis.

Water samples that require dissolved metals analysis will be passed through a 0.45 µm membrane filter immediately (within five minutes) after sampling and prior to preservation. Exposure of samples to atmospheric oxygen will be kept to a minimum. In-line filtration and use of disposable filter assemblies are preferred. Filters with larger pores may be used as pre-filters. If samples are filtered, a blank will be prepared by filtering Type II Reagent-Grade Water and submitting the blank for analysis for metals. This will be done once per

sampling round to assure that filtration does not bias sample results. Sample turbidity will be recorded and reported.

Required sample containers, preservation methods, volumes and holding times are given in Section 6.2 and Table 6-1. Sampling equipment will be decontaminated in accordance with Section 4.7 upon completion of sampling activities.

## 5.5 Subsurface Soil Sampling

Subsurface soil samples will be collected at continuous depth intervals and logged for lithological conditions as described in Section 4.2. The following subsections describe subsurface soil sampling procedures using split-spoon samplers or a hand auger.

### 5.5.1 Split-Spoon Samples

Split-spoon sampling procedures are described in the SOP, *Soil Boring Sampling – Split Spoon*, provided in Appendix B.

Split-spoon samplers used during the Basewide RI/FS will be made of stainless steel, and they will be at least 24 inches in length and 2 inches in diameter.

Each time a split-spoon sample is taken, a standard penetration test will be performed in accordance with ASTM D-1586 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils." The sample is obtained by driving the sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. The sampler is first driven 6 inches to seat it in undisturbed soil; then the test is performed. The number of hammer blows for seating the spoon and making the test are then recorded for each 6 inches of penetration on the drill log (i.e., 5/7/8). The standard penetration test result (N) is obtained by adding the last two figures (i.e., 7+8=15 blows per foot). The sampler is then driven an additional 6 inches to fill the remainder of the split-spoon prior to retrieval.

At each borehole, split-spoon samples will be screened in the field to determine which samples will be retained for laboratory analysis. In general, screening procedures will consist of 1) PID measurements; and 2) inspection of the soil sample for discoloration, staining, and odors. Field screening observations will be recorded on the soil boring log. Specific field screening procedures are described in the SOP, *Soil Boring Sampling – Split Spoon*.

Unless noted otherwise in the SSPs (Appendix A), soil samples will be retained for laboratory analysis from the depth intervals exhibiting the most evidence of contamination, based on soil screening procedures described above. If no evidence of contamination is observed in a borehole, then a sample will be retained from the depth interval immediately above the water table. Site-specific deviations from this general selection procedure are noted in the individual SSP.

Samples selected for laboratory analysis will be transferred to sample jars using a stainless steel utensil. Samples for VOC analyses will be separated and transferred first, followed by semivolatile samples. For volatile samples, mixing of soil will be avoided before and during transfer. The remainder of the soil selected for laboratory analyses will be homogenized in a stainless steel bowl using a stainless steel trowel or scoop. Homogenization procedures are described in detail in the SOP, *Homogenization of Soil and Sediment Samples*, provided in Appendix B.

Once filled, sample containers will be affixed with a completed sample label, placed in a zip lock plastic bag and placed in an iced cooler, and held at a temperature below 4°C.

### 5.5.2 Sampling by Hand Auger

If subsurface conditions consist of soft-firm clay materials (e.g. loess), a hand auger may be used to collect shallow subsurface samples during the Basewide RI/FS at Richards-Gebaur AFB. Under favorable conditions, hand auguring may be used to collect soil samples at depths of up to 8 feet below ground surface. However, the method will not be used for collecting samples that will undergo VOC analysis, because volatile compounds will likely be lost during sample retrieval and transfer.

Each hand auger boring will be advanced by manually turning a hand auger until the auger head fills with cuttings. The hand auger will then be pulled from the boring, and the cuttings deposited on plastic sheeting. The hand auguring will proceed until the sampling depth is achieved.

At the predetermined sampling depth, a manually powered hammer will be used to drive a sampler. The sampler will be driven into the bottom of the boring to a depth of 6 inches, or until refusal. The sampler will then be retrieved and the recovery determined. The sample lithology will be recorded on the boring log.

Soil selected for laboratory analysis will be homogenized in a stainless steel bowl using a stainless steel trowel or scoop. Homogenization procedures are described in detail in the SOP, *Homogenization of Soil and Sediment Samples*, provided in Appendix B. Homogenized soil will then be transferred to sample jars using a stainless steel utensil.

## 5.6 Surface Soil Sampling

Surface soil sampling activities will be conducted in accordance with the SOP, *Shallow Soil Sampling*, provided in Appendix B.

Surface soil samples will be collected from the land surface to six inches below the surface. The sample will be homogenized and quartered before being containerized. If chemicals that are highly adsorbed to clay surfaces were released at the site, an additional sample will be collected from the surface to the 1-inch depth.

Stainless steel scoops or trowels, glass jars with Teflon® lids or equivalent equipment compatible with the chemical analyses proposed will be used to collect and store samples. Exclude above ground plant parts and debris from the sample.

In addition to keeping records as outlined in Section 9.0, unusual surface conditions that may affect chemical analyses will also be noted. For example, asphalt fragments may be present on the ground surface, or the sample location is close in distance to roadways, aircraft runways, or taxiways.

## 5.7 Surface Water Sampling

Surface water sampling activities will be conducted in accordance with the SOP, *Surface Water Sampling*, provided in Appendix B.

An effort will be made to collect surface water samples at locations designated in the SSPs provided in Appendix A. If the sampling site is dry, then an effort will be made to collect surface water samples from that location soon after rainfall.



Samples will be collected so as not to cause cross-contamination. If collecting both water and sediment samples at a specific location, the water sample will be obtained first. Water pH, temperature, electrical conductivity, and dissolved oxygen will be measured and recorded at each surface water sampling point. Sample locations will be designated with a flagged stake in the nearest stream bank. Sampling locations will be recorded on a project map for each specific site or zone.

Aqueous samples collected for metals analysis will be collected in both filtered and unfiltered condition, allowing for the comparison and evaluation of the relative contributions of metals adsorbed to sediment particles versus dissolved metals.

The following sample collection sequence will be used:

- (1) if sampling both water and sediment or just sediment, start at the most downstream point and proceed upstream,
- (2) if sampling water only and the sample can be taken without disturbing the river or stream bottom, obtain any background samples first, then the farthest downstream sample, and then move upstream toward the source or discharge point,
- (3) if sampling water only and the stream or river bottom must be disturbed, start at the most downstream point and proceed upstream,

Samples will be taken from the active portion of the stream on the side nearest the source of contamination or suspected plume. Surface water samples will be collected by directly filling the sample bottles.

## 5.8 Sediment Sampling

Sediment sampling activities will be conducted in accordance with the SOP, *Sediment Sampling*, provided in Appendix B.

Sediment samples are collected from ponds, surface impoundments, and streambeds (both wet and dry). Sediment samples will be collected using a PVC tube or dredge (Ponar, Peterson, or Ekman) when water is present. Each technique allows for the collection of discrete samples, with the option of compositing samples in either the field or the laboratory. Dry sediment samples will be collected manually by hand scoop, hand auger, or using a core sampler with stainless-steel sleeves. Methods for dry sediment sampling are essentially similar as those for soil.

Where possible, sediment samples will be collected at points of deposition, such as inside an edge of a bend, at areas where a stream suddenly widens, or behind a large obstruction. The order of sample collection will be the same as that described for surface water samples.

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*6. Sample Handling*

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## 6.0 Sample Handling

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Specific sample handling procedures are outlined in Section 4.0 of the QAPP. The following provide details on sample containers, required volumes, preservation, and identification procedures.

### 6.1 Sample Containers

Sample containers are purchased precleaned and treated according to EPA specifications for the methods. Sampling containers that are reused are decontaminated between uses by the EPA-recommended procedures (i.e., EPA 540/R-93/051). Containers are stored in clean areas to prevent exposure to fuels, solvents, and other contaminants. Amber glass bottles are used routinely where glass containers are specified in the sampling protocol.

### 6.2 Sample Volumes, Containers, and Preservation

Sample volumes, container types, and preservation requirements for the analytical methods performed on AFCEE samples are listed in Table 6-1.

Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods required routinely for AFCEE work are specified in Table 6-1.

Table 6-1

## Requirements for Containers, Preservation, Sample Volumes, and Holding Times

Analytical Parameter	Analytical Method	Container <sup>a</sup>	Preservation <sup>b</sup>	Minimum Sample Volume or Weight	Maximum Holding Time
PCBs	SW8082	Water (2) 1 L G	4°C	Water 1000 ml	Water 7 days until extraction, 40 days after
		Soil: 4 oz G		Soil 30g	Soil 14 days until extraction, 40 days after
Common anions	SW9056	Water P, G	4°C	Water 50 ml	Water 28 days for Cl <sup>-</sup> and SO <sub>4</sub> <sup>-2</sup> , 48 hours for NO <sub>3</sub> <sup>-</sup>
		Soil: 2 oz G		Soil: 25g	Soil: same as water after extraction
VOCs	SW8260	Water (3) 40 ml VOA vials	4°C HCL to pH <2 <sup>b</sup>	Water 40 ml	Water 7 days if unpreserved by acid, 14 days if preserved
		Soil: 2 oz G		Soil 30g	Soil 14 days
SVOCs	SW8270	Water: (2) 1 L G	4°C	Water 1000 ml	Water 7 days until extraction, 40 days after
		Soil: 4 oz G		Soil 30g	Soil 14 days until extraction, 40 days after
TPH Volatiles	OA1	Water (3) 40 ml VOA vials	4°C HCL to pH <2 <sup>b</sup>	Water 40 ml	Water 7 days if unpreserved by acid, 14 days if preserved
		Soil: 2 oz G		Soil 30g	Soil 14 days
TPH Extractables	OA2	Water (2) 1 L G	4°C	Water: 1000 ml	Water 7 days until extraction, 40 days after
		Soil: 4 oz G		Soil 30g	Soil 14 days until extraction, 40 days after
Ferrous Iron (water only)	SM 315B	P, G	4°C	100 ml	48 hours
Mercury	SW7470 SW7471	P, G, T	4°C HNO <sub>3</sub> to pH < 2,	500 ml or 8 ounces	28 days (water and soil)
Metals (except chromium VI and mercury)	SW6010A SW6020 and SW-846 AA methods	P, G	4°C HNO <sub>3</sub> to pH < 2,	500 ml or 8 ounces	180 days (water and soil)

a Polyethylene (P), glass (G)

b No pH adjustment for soil.

## 6.3 Sample Identification

During the Basewide RI, a consistent sample identification system will be employed to ensure uniqueness and clarity in sample names. This section describes the protocol that will be followed in naming samples that are submitted to the analytical laboratory. This section does not apply to samples that are collected but not retained for laboratory analysis (e.g., split-spoon soil samples that are logged lithologically, but not submitted to the laboratory for analysis).

Each sample collected during the Richards-Gebaur AFB Basewide RI/FS will be assigned an identification number that includes the following information:

- site name (such as CS001)
- sample type
- sample location number
- sample depth (only for soil and sediment samples)

The analytical laboratory allows up to 12 characters in a sample name. Therefore, the procedures described in this section must be followed closely to prevent sample tracking problems.

### 6.3.1 Site Name

The site name will distinguish the specific site from which the sample was collected. The name will correspond to one of the 16 sites that are covered by the Basewide RI/FS. The site name is limited to 5 characters. Table 6-2 lists the site name designations that may be used for sample names:

**TABLE 6-2**  
Site Name Designations for Sample Labels  
*Basewide Remedial Investigation Work Plan, Richards-Gebaur AFB*

Text for Sample Name	Site Name and Description
AOC01	AOC-001 Central Drainage Area
AOC02	AOC-002 North Drainage Pond
AOC03	AOC-003 Firing Range
AOC10	AOC-010. Building 918 Parking Lot
CS001	CS-001. Fuel Line – 942 Section
CS002	CS-002 Oil/Water Separator at Building 704
CS004	CS-004 UST 620A
FT002	FT-002: North Burn Bit
SS003	SS-003 Oil Saturated Area

**TABLE 6-2**

Site Name Designations for Sample Labels

*Basewide Remedial Investigation Work Plan, Richards-Gebaur AFB*

Text for Sample Name		Site Name and Description
SS004	SS-004	Hazardous Waste Drum Storage Area
SS006	SS-006	Hazardous Material Storage Area
SS008	SS-008	Test Cell Area
SS009	SS-009	Fire Valve Area
ST005	ST-005	POL Storage Yard
ST007	ST-007	Former UST Area
XO001	XO-001	Belton Training Complex

### 6.3.2 Sample Type

A two-character abbreviation will designate the type of sample being collected. These abbreviations are listed below in Table 6-3.

**TABLE 6-3**

Sample Types and Symbols

*Basewide Remedial Investigation Work Plan, Richards-Gebaur AFB*

Symbol	Name	Description
MW	Monitoring Well	Groundwater samples collected from permanent monitoring wells. Also includes soil samples collected from monitoring well boreholes
SW	Surface Water	Surface water samples collected from drainage ditches, ponds, creeks, and seeps
SB	Soil Boring	Surface and subsurface soil samples collected from continuously-sampled soil borings that are not converted into monitoring wells
SS	Surface Soil	Soil samples collected, within 3 feet of ground surface, from locations that are not continuously-sampled soil borings or monitoring well boreholes.
SE	Sediment	Sediment samples collected from wet or dry drainage ditches, ponds, creek channels, and seeps.

### 6.3.3 Sample Location Number

Sample locations will be designated by three characters. Unless otherwise specified in the individual Site Sampling Plans (Appendix A), sample location numbers will be assigned sequentially in the order of sample collection.

For some samples, such as groundwater samples collected from existing monitoring well MW-1206 at the POL Yard (ST-005), the sample location would need to be designated by four characters, such as '1206'. This is acceptable as long as a sample depth does not need to be defined (see next section).

Sample types, shown in Table 6-3, will be numbered independently of each other. At each site, numbering will begin with either '001' or a number agreed upon by the BCT.

### 6.3.4 Sample Depth

Sample depths will be designated by one character. The following sample types will require a sample depth designation:

- soil samples collected from soil borings that are converted into monitoring wells
- soil samples collected from soil borings that are not converted into monitoring wells
- sediment samples

A single capital letter will designate the sample depth. The letter 'A' will represent the uppermost sample collected at a particular location. Progressively deeper samples will be lettered alphabetically (i.e. A, B, C, etc.) with depth. If only one sample is collected from a location, the sample will be designated by the letter 'A'.

An example of designating sample depths is as follows. Three samples are retained for laboratory analysis from a continuously sampled borehole. If the depth intervals for these samples are 2-4 feet below ground surface (bgs), 8-10 feet bgs, and 14-16 feet bgs, then the sample depth designations for these samples would be 'A', 'B', and 'C', respectively.

### 6.3.5 Summary of Sample Naming Process

A complete sample name will consist of the four components listed above, using the following format:

*(site name)-(sample type)(sample location number)(sample depth).*

For example, 'ST001-SB002A', would represent the uppermost soil sample collected from soil boring SB-2, located at Site ST-001. 'XO001-MW004B' would represent the next-to-shallowest soil sample collected from the borehole where monitoring well MW004 was later installed at Site XO-001. 'XO001-MW004' would represent a groundwater sample that was collected from MW004 at Site XO-001.

Note that the sample depth is not included in the names of groundwater, surface water, and surface soil samples.

### 6.3.7 Naming of QA/QC Samples

Descriptions of QA/QC samples are provided in Section 7.0. This subsection describes how identification numbers will be assigned to QA/QC samples during the Basewide RI.

Ambient blanks (AB), trip blanks (TB), will be named according to the following examples:

*AB-01-111599: the first ambient blank on November 15, 1999*

*TB-01-111599: trip blank sample submitted with first cooler of  
VOC samples packaged on November 15,  
1999.*

The first AB or TB sample collected on a given day will be numbered, '01'.

Equipment blanks (EB) will be named according to the following example:

*EB-01-111599: the first equipment blank collected on  
November 15, 1999*

Since several field teams will be collecting equipment blanks on a given day, care must be taken to avoid duplicating sample names. The first EB collected each day will be numbered, '01'.

Matrix spike/matrix spike duplicate (MS/MSD) samples will be named identically to ordinary environmental samples, except the symbols, 'MS' and 'MSD' will be added to the end of the sample name to indicate matrix spikes and matrix spike duplicate samples, respectively. For example:

*ST001MS002A matrix spike*

*ST001MSD002A matrix spike duplicate*

Because sample names are limited to 12 characters, MS/MSD samples will not include the two-letter sample type code (Section 6.3 2). This should not cause a sample-tracking problem, since the sample matrix will be recorded in a separate field in the database.

Field duplicates (FD) will be named in the field according to the following example:

*ST001-SBFD02 the second field duplicate soil sample collected  
from ST 001*

Again, since multiple field teams will be collecting samples simultaneously, the teams must communicate with each other to avoid duplication of sample names. The first FD collected at each site and for each sample matrix will be numbered '01'



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7. Sample Custody

## 7.0 Sample Custody

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### 7.1 Chain of Custody

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

The contractor will maintain chain-of-custody records for all field and field QC samples. A sample is defined as being under a person's custody if any of the following conditions exist:

- (1) it is in their possession,
- (2) it is in their view, after being in their possession,
- (3) it was in their possession and they locked it up or,
- (4) it is in a designated secure area.

All sample containers will be sealed in a manner that will prevent or detect tampering if it occurs. In no case will tape be used to seal sample containers. Samples will not be packaged with activated carbon unless prior approval is obtained from the AFCEE.

The following minimum information concerning the sample will be documented on the AFCEE chain of custody form (example provided in Appendix C).

- Unique sample identification
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Designation of Matrix Spike/Matrix Spike Duplicates (MS/MSD)
- Preservative used
- Analyses required
- Names of sampling team
- Pertinent field data (pH, temperature, etc.)
- Serial numbers of custody seals and transportation cases (if used)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories
- Bill of lading or transporter tracking number (if applicable)

All samples will be uniquely identified, labeled, and documented in the field at the time of collection in accordance with Section 6.3 of the FSP.

Samples collected in the field will be transported to the laboratory or field testing site as expeditiously as possible. When a 4°C requirement for preserving the sample is indicated, the samples will be packed in ice or chemical refrigerant to keep them cool during collection and transportation. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. A temperature blank (a volatile organics compounds sampling vial filled with water) will be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory.

## 7.2 Field QA/QC Samples

### 7.2.1 Ambient Blanks

The ambient blank consists of ASTM Type II reagent grade water poured into a VOC sample vial at the sampling site. It is handled like an environmental sample and transported to the laboratory for analysis. Ambient blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes.

Ambient blanks are used to assess the potential introduction of contaminants from ambient sources (e.g., active runways, engine test cells, gasoline motors in operation, etc.) to the samples during sample collection. Ambient blanks will be collected downwind of possible VOC sources.

One ambient blank will be collected at a minimum of 25 percent of the sites where VOC samples are being collected

### 7.2.3 Equipment Blanks

An equipment blank is a sample of ASTM Type II reagent grade water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures. Equipment blanks will be collected immediately after the equipment has been decontaminated. The blank will be analyzed for all laboratory analyses requested for the environmental samples collected at the site.

Equipment blanks will be collected at a minimum of one set per day for each sampling team

### 7.2.4 Trip Blanks

The trip blank consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken and are analyzed only for VOC analytes. Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. One trip blank will accompany each cooler of samples sent to the laboratory for analysis of VOCs.

### 7.2.5 Matrix Spike / Matrix Spike Duplicates

A matrix spike (MS) and matrix spike duplicate (MSD) is an aliquot of sample spiked with known concentrations of analytes. The spiking occurs prior to sample preparation and analysis.

To allow the analytical laboratory to run MS/MSD analyses, additional samples will be collected in the field to provide sufficient sample volume. A minimum of one MS and one MSD sample will be analyzed for every 20 AFCEE samples.

### **7.2.6 Field Duplicates**

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (i.e. blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

Duplicate sample results are used to assess precision of the sample collection process. Precision of soil samples to be analyzed for VOCs is assessed from collocated samples because the compositing process required to obtain uniform samples could result in loss of the compounds of interest.

Field duplicates will be collected at a frequency of 10 percent per site

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*8. Field Measurements*

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## 8.0 Field Measurements

### 8.1 Parameters

A summary of field parameters that will be measured during the Basewide RI/FS at Richards-Gebaur AFB is provided in Table 8-1:

**TABLE 8-1**  
Summary of Field Parameters  
*Basewide Remedial Investigation Work Plan, Richards-Gebaur AFB*

Field Parameter	Instrument
Soil Headspace	MiniRae Photoionization Detector
Groundwater Level	Electronic Water Level Checker (Solonist® or Equivalent)
LNAPL Thickness <sup>1</sup>	Interface Probe (Solonist® Model 122 Interface Meter or Equivalent)
Water Temperature	Horiba U-10 Water Quality Multiprobe
Water Dissolved Oxygen	Horiba U-10 Water Quality Multiprobe
Water Conductivity	Horiba U-10 Water Quality Multiprobe
Water Turbidity	Horiba U-10 Water Quality Multiprobe
Water pH	Horiba U-10 Water Quality Multiprobe
Water Oxidation/Reduction Potential (ORP)	Oakton ORP Tector

<sup>1</sup> LNAPL thickness measurements will be made if a nonconductive floating product layer is suspected in the well

### 8.2 Equipment Calibration and Quality Control

Because water level checker, interface probe, and ORP meter cannot be calibrated in the field, they will be exchanged for properly functioning equipment if these instruments malfunction or return inaccurate measurements.

Calibration procedures for the Horiba® U-10 water quality multiprobe are described in the SOP, *Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, and Temperature Using the Horiba® U-10*. For the MiniRae® PID meter, calibration procedures will be followed in accordance with the manufacturer's specifications.

## 8.3 Equipment Maintenance and Decontamination

Maintenance of field equipment will be conducted on at least a weekly basis. Equipment maintenance procedures will be followed in accordance with manufacturers' specifications. Major repairs of field equipment will not be attempted by field staff – equipment will be shipped back to the manufacturer if repairs are required.

Prior to any measurement activities, field equipment will be decontaminated according to the specifications in Section 4.7. Decontamination of field equipment will also occur between sampling locations.

## 8.4 Field Monitoring Measurements

### 8.4.1 Groundwater Level Measurements

Ground-water level measurements will be performed in accordance with the SOP, *Water Level Measurements*, provided in Appendix B.

Water-level measurements will be taken in all wells and piezometers to determine the elevation of the water table or piezometric surface at least once within a single 24-hour period. These measurements will be taken after all wells and piezometers have been installed and developed and their water levels have recovered completely. Any conditions (e.g., barometric pressure) that may affect water levels will be recorded in the field log. The field log will also include the previous water level measurement for each well (to determine if the current water level is reasonable).

Water-level measurements will be taken with electric sounders, air lines, pressure transducers, or water-level recorders (e.g., Stevens recorder). Devices that may alter sample composition will not be used. Pressure gauges, manometers, or equivalent devices will be used for flowing wells to measure the elevation of the piezometric surface. All measuring equipment will be decontaminated according to the specifications given in Section 4.7. Ground-water level will be measured to the nearest 0.01 foot. Two or more sequential measurements will be taken at each location until two measurements agree to within +/- 0.01 foot.

Static water levels will be measured each time a well is sampled, and before any equipment enters the well. If the casing cap is airtight, allow time prior to measurement for equilibration of pressures after the cap is removed. Repeat measurements until water level is stabilized.

### 8.4.2 Floating Hydrocarbon Measurements

Floating hydrocarbon measurement procedures are included in the SOP, *Water Level Measurements*, provided in Appendix B.

The thickness of hydrocarbons floating in monitoring wells will be measured with an electronic interface probe. Hydrocarbon detection paste, or any other method that may affect water chemistry, will not be used. When detected, the presence of floating hydrocarbons will be confirmed by withdrawing a sample with a clear, bottom-fill Teflon<sup>®</sup> bailer.

### 8.4.3 Ground-water Discharge Measurements

Ground-water discharge measurements will be obtained during monitoring well purging and aquifer testing. Ground-water discharges may be measured with orifice meters, containers of known volume, in-line meters, flumes, or Weirs, following the guidelines specified in the *Water Measurement Manual*, Bureau of Reclamation, 1967. Measurement devices will be calibrated using containers of known volume.



# TAB

9. Record Keeping

## 9.0 Record Keeping

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This section describes the procedures used to track field samples and identifies documentation procedures, project file requirements, and project-related reporting. It also presents the format that should be used to present raw data and conclusions of the investigation.

### 9.1 General Field Documentation Procedures

The following field forms will be completed during the Basewide RI/FS at Richards-Gebaur AFB:

- soil boring logs
- monitoring well installation forms
- monitoring well sampling forms
- surface water sampling forms
- daily field activity logs
- chain of custody forms

Examples of these forms are provided in Appendix C.

Field documentation will be recorded in logbooks during the Basewide RI/FS at Richards-Gebaur AFB. All entries will be recorded in indelible, waterproof ink. If errors are made in any field logbook, field form, Chain-Of-Custody Record, or any other field document, corrections will be made by crossing a single line through the error, entering the correct information, initialing, and dating the information.

Documentation of events will be made in chronological order on the right page of the logbook. The left page of the logbook will be used for auxiliary reporting, such as sketches, tables, providing details or comments on events reported sequentially, or interpretations. Data recorded on field forms, provided in Appendix C, will not be repeated in the logbook.

The date will be placed at the top of every page in the left-hand corner of the right page. The time of entry recordings will be in columnar form down the left-hand side of the right page. If an entry is made in a non-dedicated logbook, then the date, project name, and project number will be entered left to right, respectively, along the top of the right page. All entries will be dated, and time of entry recorded. At the beginning of each day, the first two entries will be "Personnel/Contractors On Site" and "Weather". At the end of each day's entry or particular event, if appropriate, the personnel will draw a diagonal line originating from the bottom left corner of the page to the conclusion of the entry and sign along the line, indicating the conclusion of the entry or the day's activity.

Entries in the field logbook will be legible and will contain accurate and inclusive documentation of all project activities, such as drilling, sample collection, and field measurements. Information pertaining to health and safety aspects, personnel on site, visitors' names, association, and time of arrival/departure will also be logged. Language in the field books must be objective and factual. Once completed, field logbooks will become accountable documents and must be maintained as part of the project files. Periodic audits of field logbooks will be conducted to ensure compliance with this procedure.

All aspects of sample collection and handling, as well as visual observations, will be documented in the field logbooks. Sample collection equipment and field measurement equipment will be identified in the field logbooks. All calculations, results, and calibration data for field sampling and measurement of field parameters will also be recorded in the logbooks, except where the data are referenced as being recorded on approved field forms. Field measurements must be traceable to the specific piece of field equipment and to the field investigator making the measurement.

In addition to the field forms listed above, each sampling team will record general site observations in the field logbook.

## 9.2 Sample Tracking Program

Before each field sampling effort, the database manager will set up the project information in CH2M HILL's Sample Tracking Program (STP). The STP will be used to print sample labels and chain-of-custody forms for each sampling team. Sample labels contain the following information:

- Laboratory name and address
- Project name
- Sample ID
- Station ID
- Preservation required
- Analysis requested
- Lot control ID
- A blank line for the sampler's initials and collection date and time

The chain-of-custody form will contain the following information:

- Sample ID
- Site ID
- Station ID
- Collection date and time
- Sample matrix
- Number of containers
- Analyses requested
- Lot control ID
- Comments

In addition, the STP will produce daily assignment forms for the field team leader that contain information about the stations to be sampled and daily completion report forms that can be used to track all completed stations and field QA/QC samples.

Table 9-1 lists the information to be gathered in the field and entered into the STP. The Field Team Leader is responsible for the completeness of the data entered into the STP system. The QAPP provides codes for a number of the fields (e.g., ASTM CODE and LITH CODE) that will be entered into the STP system.

**TABLE 9-1**  
**STP Field Information**  
*Basewide RI/FS Work Plan, Richards-Gebaur AFB*

<b>STP Name</b>	<b>Description</b>	<b>Comments</b>
ASTMCODE	ASTM codes for classification of unconsolidated deposits	Collected by the site hydrogeologist and documented in the soil boring logbook.
BEGDEPTH	Beginning depth	Upper depth of a lithologic stratum, measured below the ground surface in feet.
BHDIAM	Borehole diameter	The diameter of a borehole in inches.
CASDIAM	Casing inside diameter	The inside diameter of the screened interval.
CMACODE	Casing material code	Identifies the material used as a well casing.
CMCCODE	Construction method code	Identifies the method by which a borehole was constructed.
DEPTH	Borehole depth	The total depth of a borehole measured in feet relative to ground surface.
DRLCODE	Drilling company code	Identifies the organization that drilled a borehole at a sampling or measuring location.
ECOORD	East state plan coordinate	The x-value (east-west) of the distance in feet of a sampling or measuring location from the reference location of known state plane coordinates. Installation Restoration Program Information Management System (IRPIMS) will not accept data for sites without this information
ELEV	Surface elevation	Elevation of ground or water surface at a sampling location, recorded in feet above mean sea level (msl)
ENDDEPTH	End depth	Lower depth of a lithologic stratum, measured below the ground surface in feet
ESTDATE	Date established	Construction date that the sampling location was completed
EXCCODE	Excavating company code	Identifies the organization that excavated a sampling location
FPL	Filter pack length	The length in feet from the bottom of the seal to the bottom of the borehole
GFCCODE	Geohydrologic flow classification	Describes the hydraulic relationship between a location and a site
GZCCODE	Geologic completion zone	General hydrologic description of the well completion zone
INSDATE	Installation date	Date that the well casing was installed
LITHCODE	Lithology code	Identifies the lithologic description of a layer

(CONTINUED)

**TABLE 9-1 (CONTINUED)**  
**STP Field Information**  
*Basewide RI/FS Work Plan, Richards-Gebaur AFB*

STP Name	Description	Comments
LOCDESC	Location description	Additional information needed to describe a sampling location, in text format.
LOCID	Location identification	Unique identifier assigned to a location within an Air Force installation where measurements are taken
LOGCODE	Logging code	Company responsible for logging, testing, or collecting samples from a borehole
LOGDATE	Log date	Date that a water level measurement is made or a sample is taken.
LOGTIME	Log time	Time of day that a water level measurement is made or a sample is taken, use 24-hour time with no colon
LOTCTLNUM	Lot control number	Number denoting a set of samples that comprises an autonomous group of field environmental samples and field QC samples
MATRIX	Sampling matrix	Identifies the sample medium actually being analyzed, for QC blanks and reference materials, codes such as WQ, SQ, and AQ are used
MPELEV	Measuring point elevation	Elevation of the measurement reference point (normally the elevation where the top of casing is notched) used for groundwater depth level measurements, expressed in feet above msl
NCOORD	North state plane coordinate	The y-value (north-south) of a distance in feet of a sampling or measuring location from the reference of known state plane coordinates, IRPIMS will not accept data for sites without this information.
PCTOPEN	Percent open area	Percent of screened interval that is open for water flow.
REMARKS	Remarks	Comments describing the purpose of the well or identifying the geologic formation of completion
SACODE	Sample type code	Identifies the QC type of sample collected
SAQCODE	Sole source aquifer code	Identifies the sole source aquifer in which the well was completed
SBD	Sample beginning depth	The upper depth in feet from the ground or water surface at which a sample is collected
SBDEPTH	Screen beginning depth	Depth in feet at which the top of the screen is placed, relative to the ground surface
SCRDIAM	Screen diameter	Inside diameter of the screened interval in inches
SCRENGTH	Screen length	The length in feet of the screened interval

(CONTINUED)

**TABLE 9-1 (CONTINUED)**  
**STP Field Information**  
*Basewide RI/FS Work Plan, Richards-Gebaur AFB*

STP Name	Description	Comments
SED	Sample ending depth	Lower depth in feet at which a soil sample is collected for analysis, relative to ground surface.
SEDEPTH	Seal end depth	Depth in feet at which the bottom of the bentonite seal is positioned, relative to the ground surface
SITENAME	Site name	The name of a site, such as landfill or fire training area.
SITEXREF	Site cross reference	The abbreviated name for a site.
SMCCODE	Sampling method code	Identifies the sampling method used to collect a sample
SOUA	Screen slot size	The vertical size of the slot opening in inches.
SOUNDING	Sounding	The total depth to the bottom of the well in feet at the time of testing, measured from the reference point (normally the elevation where the top of casing is notched)
STATDEP	Static water depth	The depth to water in feet measured from the measuring point for the well under static conditions
STRATORDER	Stratigraphic order	The number assigned by the site geologist to each distinct lithologic interval at a site
TOTDEPTH	Total casing depth	The total depth in feet of the well casing including screen, blank casing, and well foot, relative to the ground surface
VISDESC	Visual description	Textural and mineralogical description of the material comprising the layer to augment or qualify the lithologic codes
WCMCODE	Well completion material code	Identifies the method used to complete the well or the nature of the openings that allow water to enter the well.
WELCODE	Well owner code	Identifies the owner of a well that is monitored
WTCCODE	Well type classification code	Identifies the type of well.

## 9.2 Laboratory Electronic Deliverables

Columbia Analytical Services, Redding, CA, will deliver the analytical data to the database manager in electronic format using either a Windows-formatted electronic mail system, high-density floppy (3.5-inch) diskettes, or CD-ROM disks. The electronic deliverable from the laboratory will be a comma-delimited ASCII file that will be combined with the information in the STP to complete the IRPIMS BCHTEST (Batch Test) and BCHRES (Batch Results) files. The database manager will execute a program that loads the data from the laboratory into the Environmental Data Management System (EDMS).

### 9.3 ERPIMS Electronic Deliverables

All data submissions to AFCEE will be on 3.5-inch high-density diskettes, or CD-ROM disks. Each submission will include a transmittal letter that contains the contract and delivery order number and identifies the submission group, included files, and excluded files with a reference to the statement of work (SOW). Table 9-2 is a complete list of ERPIMS data file names and descriptions.

**TABLE 9-2**  
**IRPIMS Data File Names and Descriptions**  
*Basewide RI/FS Work Plan, Richards-Gebaur AFB*

<b>IRPIMS Name</b>	<b>Description</b>	<b>Comments</b>
BCHCON	Batch contract information	
BCHLDI	Batch location definition information	Necessary for all new soil, groundwater, surface water, and sediment sampling locations
BCHSLI	Batch site and location information	Requires that each sampling location be classified as upgradient, downgradient, or cross-gradient with respect to a reference point. BCHSLI can be submitted on paper.
BCHWCI	Batch well completion information	Necessary for all new groundwater sampling locations entered into the STP in the <i>Well Completion</i> section.
BCHGWD	Batch groundwater level data	Field notes are the source of this data entered into the STP in the <i>Groundwater Level</i> section. Necessary for all new monitoring well locations and groundwater sampling locations.
BCHLTD	Batch lithology data	Necessary for all new soil borings and monitoring wells.
BCHSAMP	Batch environmental sampling information	Field personnel are responsible for entering this information into the STP in the <i>Sample Setup</i> and <i>Sample Login</i> sections.
BCHTEST	Batch sample preparation information	
BCHRES	Batch analytical results	

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*Appendix A — SSPs*

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## **APPENDIX A**

## **SITE SAMPLING PLANS**



# 1.0 SSP – AOC 001

## Central Drainage Area

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### 1.1 Introduction

This site sampling plan describes the proposed sampling approach at AOC 001. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

#### 1.1.1 Site Description

AOC 001, the Central Drainage Area, is located in the northwestern portion of Richards-Gebaur Air Force Base (AFB), south of the flightline and Hangar Road and northeast of Building 930 (**Figure A.1**). The Central Drainage Area was designed to collect and channel surface runoff from the runways and flightline through the central area of the Base. The site is comprised of two drainage channels that converge to form a single stream.

The stormwater drainage originates from the flightline collection system and flows under Hangar Road through two 30-inch corrugated metal pipe culverts (CMP) and a 54-inch CMP before surfacing in the Central Drainage Area. The culvert mouths are located near the foot of the slope that leads down to the beginning of the two drainage area channels.

The south channel is fed by a 30-inch and a 54-inch culvert and conveys stormwater captured from around Buildings 918, 965, and 966. Seeps of water have been observed emitting from the hill slope north of the culvert mouths. The source of the seeps has not been identified in the past. In 1998 the seeps were investigated by Richards-Gebaur AFB personnel and are now believed to be the result of a water main break.

The north channel primarily collects runoff from the vicinity of Building 940, and is fed by a single 30-inch CMP culvert. The north channel enters the south channel approximately 500 feet downstream of south channel's origin.

The combined drainage is conveyed eastward to a second 54-inch culvert that passes under Corkill Road. The stormwater eventually enters Scope Creek and flows northeast and offsite. Numerous small trees and shrubs have taken root next to the small streams and the area appears in a natural state, free of buildings and pavement.

#### 1.1.2 Summary of Previous Investigations

The site was initially investigated in 1993 (Burns and McDonnell, 1993b). The results of the investigation indicated that lead concentrations in two sediment samples were above the previously applicable State ASL of 240 ppm. In addition, one sample was found to contain vinyl chloride at a trace concentration of 0.56 ppm, a level below the previous State ASL of 2.6 ppm.

In 1996, a follow-up investigation was conducted to confirm the presence of the contaminants of concern (COC) found in the 1993 investigation (Versar, 1996c). Soil samples, sediment samples, and surface water samples were collected from around the

stream channels, the seeps, from within stormwater manholes, and adjacent to the culvert mouths.

Sampling locations examined during previous site investigations are displayed in **Figure A.2**.

### 1.1.3 Current Site Status

The Central Drainage Area continues to convey surface water and storm sewer effluent from the Base facilities. The two previous site investigations, conducted by Burns and McDonnell (1993b) and Versar (1996c), have identified concentrations of metals in soil and sediment samples that exceed applicable State guidelines.

## 1.2 Chemicals of Concern

The primary COC at the Central Drainage Area are volatile organic compounds (VOCs) and metals. Both groups of chemicals have been detected in the sediments collected from the drainage ditches. It should be noted, however, that much of the available site-specific data were J-qualified, indicating that the analytes were positively identified but the reported concentrations were estimated values.

### 1.2.1 Soil

Eight surface soil samples were collected from the site and analyzed for VOCs, polychlorinated biphenyls (PCBs) and metals (Versar, 1996c). The samples were collected from a depth of 0 to 6 inches along the banks of the channels. Several VOCs (2-hexanone, acetone, and methylbenzene) were detected, but at concentrations below their respective soil target concentration (STARC). The chemicals are also common laboratory contaminants and were attributed to a laboratory source.

Thallium was detected in three of the eight samples at concentrations ranging from 5.4 ppm to 8.6 ppm. The CALM Scenario B STARC for thallium is 24 ppm. Thallium concentrations detected in the soil samples are within the reported background range of concentrations of thallium, which can be as high as 15 ppm in this region of Missouri (USACE, 1996).

### 1.2.2 Groundwater

No groundwater samples have been collected at the site.

### 1.2.3 Surface Water

Seven surface water samples were collected from the drainage channels and the seep (Versar, 1996c). The samples were analyzed for VOCs, PCBs, and metals. Several VOCs were detected in six samples collected from near the upstream culvert mouths.

Trichloroethene was detected once only in a seep sample at a concentration of 10 ppb, and *cis* 1,2-dichloroethene was detected at four locations in concentrations ranging from 1.5 ppb to 18 ppb. There are no available State criteria for the protection of freshwater aquatic life for these compounds. The Maximum Contaminant Level (MCL) for trichloroethene is 5 ppb, and the MCL for *cis* 1,2-dichloroethene is 70 ppb. No PCBs were detected. Metals were detected but at concentrations below their respective applicable MCLs.

Five stormwater samples were collected: one from each of the three upstream culverts and the two manholes. In addition, two stormwater samples were collected from a stormwater

inlet south of Building 918, and from a manhole west of Building 940. The samples were analyzed for VOCs, TPH, and metals (Versar, 1996c). VOCs were not detected. Total petroleum hydrocarbon (TPH) constituent concentrations of 42 ppb and 1,200 ppb were reported in the samples from the stormwater inlet and the manhole. Aluminum, copper, iron, lead, selenium, silver and thallium were reported at concentrations that exceeded the State of Missouri Freshwater Aquatic Life Criteria for acute and/or chronic exposures.

#### 1.2.4 Sediments

A total of twenty-nine sediment samples were collected from the channel bottoms, two seeps located near the main channel culvert, stormwater inlets and one manhole (Versar, 1996c). The samples were analyzed for VOCs, PCBs, and metals.

Vinyl chloride was detected during the initial site investigation in one sediment sample at a concentration of 0.56 ppm (Burns & McDonnell, 1993b). This result exceeds the current CALM  $C_{IDI}$  value of 0.34 ppm and  $C_{leach}$  value of 0.016 ppm. However, no VOCs were detected at concentrations above their respective STARC levels in any samples during the second site investigation (Versar, 1996c). No PCBs were detected in the sediment samples.

Lead, cadmium, manganese, and beryllium were detected at concentrations exceeding their respective MDNR STARC levels (Versar, 1996c).

### 1.3 Objectives and Scope

The objectives of the site investigation at AOC 001 are as follows:

- evaluate presence and concentration of COC in sediment
- evaluate presence and concentration of COC in surface water

To meet these objectives, the following field activities will be performed at AOC 001:

- collect nine surface water samples
- collect nine sediment samples
- analyze surface water and sediment samples for VOCs, SVOCs, TPH, and metals

If COC in surface water and sediment samples are found at concentrations exceeding action levels, the scope of work will be expanded to satisfy the following additional objectives.

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater
- evaluate potential for natural attenuation at the site

If necessary, a Phase 2 investigation will be performed at AOC 001 to meet the objectives listed above. The following tasks will be conducted during the Phase 2 investigation:

- install up to six monitoring wells
- collect a total of up to six soil samples, one from each monitoring well boring
- measure groundwater elevations in each well
- collect groundwater samples from each well
- analyze soil and groundwater samples for VOCs, SVOCs, TPH, and metals
- analyze groundwater samples for natural attenuation parameters

### 1.3.1 Field Methodologies

The field and analytical methodologies to be used at AOC 001 are summarized below.

#### 1.3.1.1 Monitoring Well Installation

Should the Phase 2 investigation be necessary, up to six new monitoring wells will be installed at AOC 001. Each well will be drilled between 6 and 18 inches into the upper bedrock unit. The proposed well locations are shown in **Figure A.3**. Monitoring well locations may be modified during the Basewide RI, depending on the location of underground utilities. The monitoring wells will be installed and developed according to the procedures described in the FSP.

#### 1.3.1.2 Groundwater Sampling

If the Phase 2 investigation is performed, groundwater samples will be collected from each of the newly installed monitoring wells. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs, semi-volatile organic compounds (SVOCs), TPH, and metals. Groundwater samples collected during the Phase 2 investigation will also be analyzed for natural attenuation parameters.

#### 1.3.1.3 Soil Sampling

Soil samples will only be collected during the Phase 2 investigation. The samples will be collected during the drilling of monitoring well borings. Each boring will be continuously sampled from the surface to completion. Up to six soil samples, one from each well boring, will be retained for laboratory analyses. The samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. The selected samples will be analyzed for VOCs, SVOCs, TPH, and metals.

#### 1.3.1.4 Surface Water Sampling

When present in the drainage channels, surface water samples will be collected from the site during the Phase 1 investigation. If surface water is not initially present, an effort will be made to collect samples after it rains. Surface water sampling locations are shown in **Figure A.3**. Two surface water samples will be collected from seeps that enter the south channel. Seven surface water samples will be collected in the north and south channels. The surface water sampling locations will correspond to sediment sampling locations, wherever possible. Samples will be collected according to the procedures specified in the FSP and analyzed for VOCs, SVOCs, TPH, and metals.

#### 1.3.1.5 Sediment Sampling

During the Phase 1 investigation, nine sediment samples will be collected and analyzed for VOCs, SVOCs, TPH, and metals. Sample locations are shown in **Figure A.3**. Two sediment samples will be collected from seeps that enter the south channel. Seven sediment samples will be collected in the north and south channels. Sediment samples will be collected according to the procedures specified in the FSP.

#### 1.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project Quality Assurance Project Plan (QAPP), additional samples will be collected at AOC 001 to provide quality control. The following QA/QC samples will be collected during the Phase 1 investigation:

- one duplicate surface water sample
- one duplicate sediment sample

The following QA/QC samples will be collected during the Phase 2 investigation:

- one duplicate soil sample
- one duplicate groundwater sample

In addition to field duplicates, other QA/QC samples may be collected during the Phase 1 and Phase 2 investigations at AOC 001. These samples may include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

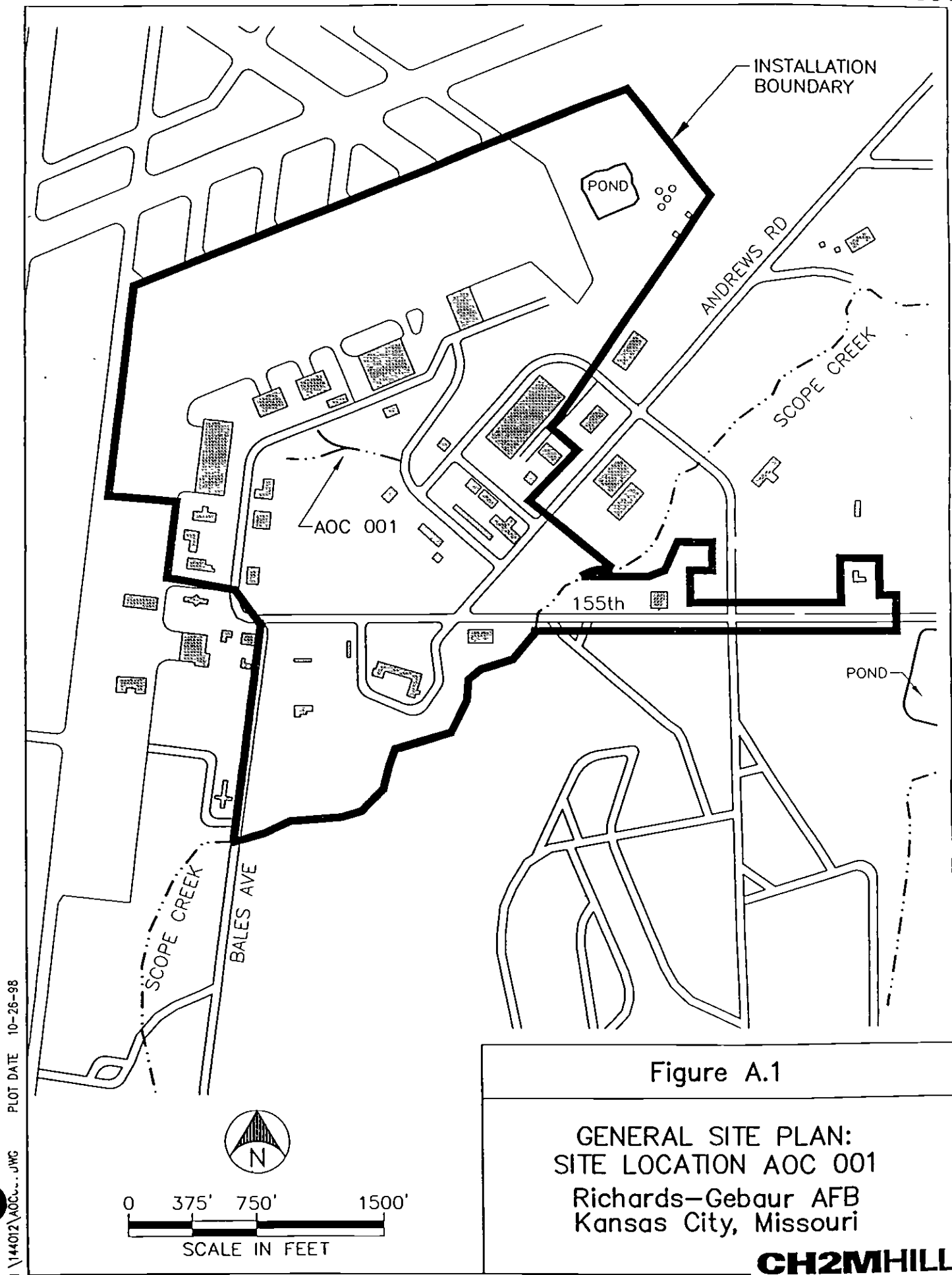
### 1.3.3 Laboratory Analyses

**Table A-1** lists the analytical parameters for soil, groundwater, surface water, sediment and associated QC samples.

**Table A-1 Summary of Sample Analyses - AOC 001**

PHASE 1 INVESTIGATION						
Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Sediment	9	√	√	√	√	
Surface Water	9	√	√	√	√	
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicates <sup>2</sup>	2	√	√	√	√	
Notes 1. In addition to field duplicates, other QA/QC samples may consist of ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP. 2. At least one field duplicate shall be collected for each sample medium						

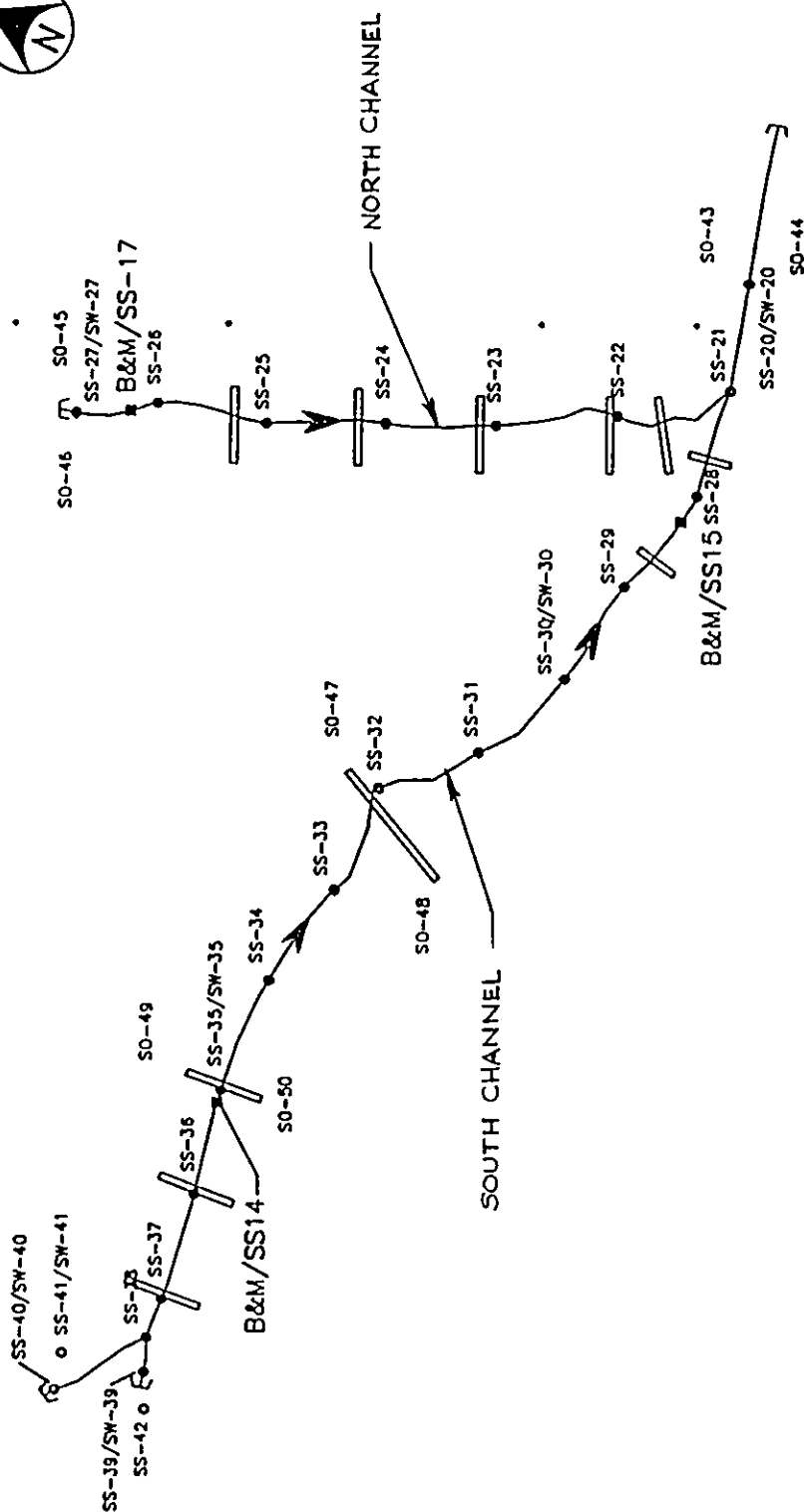
PHASE 2 INVESTIGATION						
Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater <sup>1</sup>	6	√	√	√	√	
Soil	6	√	√	√	√	
<b>QA/QC Samples<sup>2</sup></b>						
Field Duplicates <sup>3</sup>	2	√	√	√	√	
Note 1. Groundwater samples will be analyzed for natural attenuation parameters (dissolved oxygen, redox, alkalinity, pH, conductivity, NO <sub>3</sub> <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , Fe <sup>2+</sup> , and Cl <sup>-</sup> ) 2. In addition to field duplicates, other QA/QC samples may consist of ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP. 3. At least one field duplicate shall be collected for each sample medium						



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AFTER VERSAR INC, 1996





# LEGEND

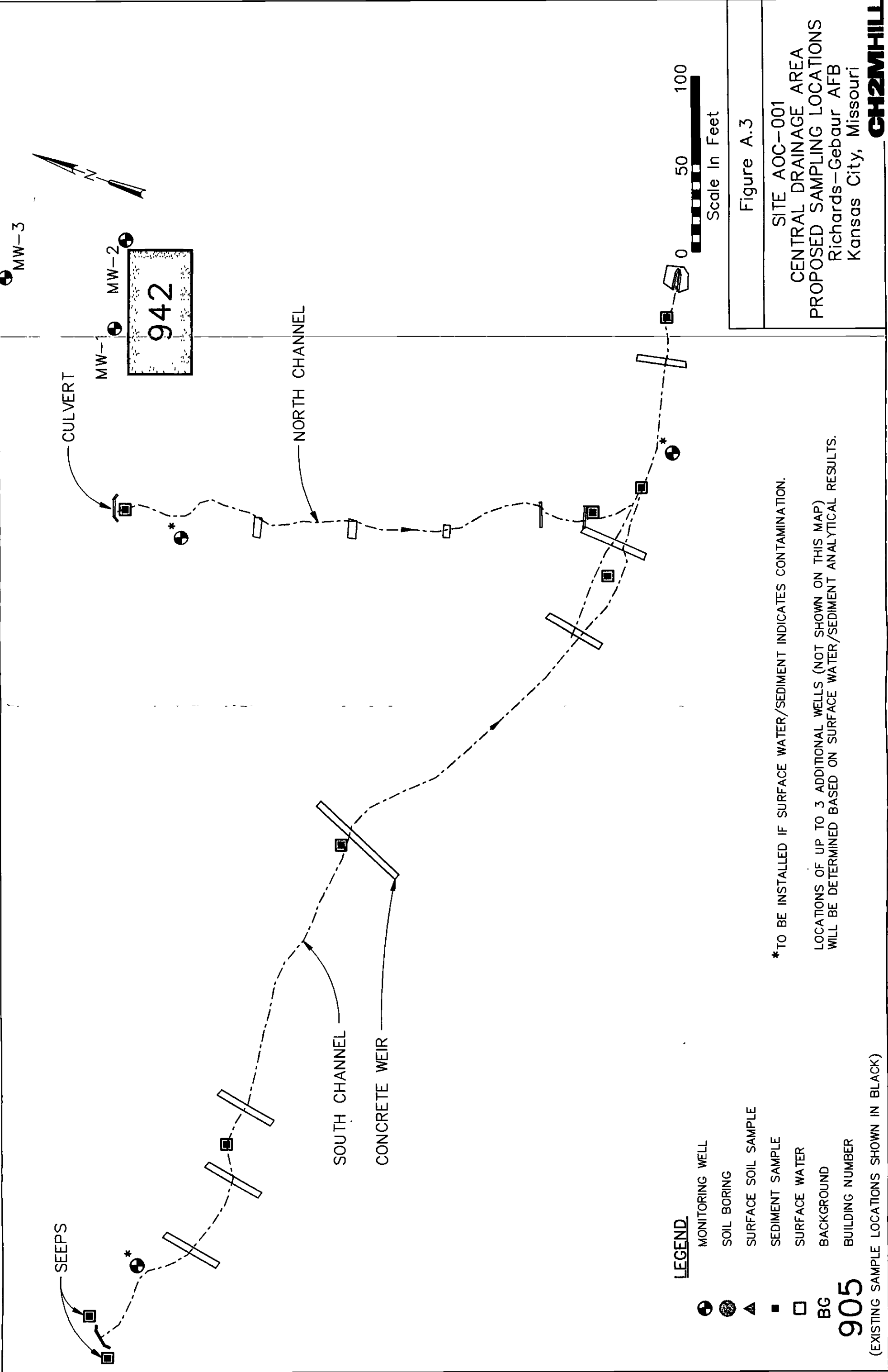
- SEDIMENT SAMPLE LOCATIONS
- SURFACE WATER SAMPLE LOCATIONS
- SURFACE SOIL SAMPLE LOCATIONS
- PREVIOUS SEDIMENT SAMPLE LOCATIONS
- == CONCRETE WEIRS

Figure A.2

SOIL SAMPLE LOCATION MAP  
SITE LOCATION AOC 001

Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**



## 2.0 SSP – AOC 002

### North Drainage Pond

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#### 2.1 Introduction

This site sampling plan describes the proposed sampling approach at AOC 002. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the Evaluation and Consolidation Study (ECS) report (CH2M HILL, 1998).

##### 2.1.1 Site Description

AOC 002, the North Drainage Pond, is located in the northeast portion of Richards-Gebaur AFB, west of the POL Yard and east of the airfield (**Figure A.4**). The site covers an area of about 36,000 square feet. The pond, which receives runoff from the flightline, is a diked impoundment constructed with two underlying layers of gravel and bentonite separated by a geotextile liner. Beneath the impoundment liner is a french drain system that intercepts groundwater that might otherwise infiltrate to greater depths. The french drain collection system discharges at the ground surface south of the pond (USAF, 1995a).

The site discharges to a nearby drainage channel that feeds an oil/water separator (OWS). During storms, excess surface water runoff may bypass the retention pond and the OWS by flowing through an influent bypass and discharging to the ground surface at the bypass outfall, located immediately south of the drainage pond. The pond is typically dry, except after heavy rain.

##### 2.1.2 Summary of Previous Investigations

The North Drainage Pond was constructed in 1975 and was designed to collect surface stormwater runoff from the flightline and runways located immediately to the north and west. The impoundment conveys the runoff to the Little Blue River Sewage Treatment plant. Prior to 1983, effluent from the pond was treated at the Base sewage treatment plant.

In 1993, an environmental assessment was performed at the North Drainage Pond (Tetra Tech, 1995a and 1995b). The purpose of the assessment was to determine whether the site sediments had received and retained contaminants in quantities or concentrations that required further investigation. Sediment samples and surface water samples were collected from within the North Drainage Pond and analyzed for TPH compounds, VOCs, SVOCs, PCBs, pesticides, herbicides, and metals. In 1994, one groundwater monitoring well was installed at the site to a depth of 29 feet.

In addition to the 1993 environmental assessment, two sediment samples (SS-22 and SS-23) were collected near the drainage pond as part of a Base application for a National Pollutant Discharge Elimination System (NPDES) permit (USAF, 1995a). Sampling locations examined during previous site investigations are displayed in **Figure A.5**.

### 2.1.3 Current Site Status

The site is fenced and public access is prohibited. The pond still receives runoff from the flightline, now largely disused.

## 2.2 Chemicals of Concern

The COC at the North Drainage Pond represent a variety of constituents that could become entrained in surface water runoff from the flightline and runways. Petroleum hydrocarbons, VOCs, SVOCs, and metals are COC at the site.

### 2.2.1 Soil

No soil samples have been collected at the North Drainage Pond.

### 2.2.2 Groundwater

Two groundwater samples were collected from the one site groundwater monitoring well (Tetra Tech, 1995a). The samples were analyzed for TPH, VOCs, SVOCs, pesticides, herbicides, PCBs, and metals. None of the chemicals were present at concentrations exceeding MCLs

### 2.2.3 Surface Water

Only one surface water sample was collected from the site because the pond was almost dry at the time of investigation (Tetra Tech, 1995a). The sample was analyzed for the same parameters as the groundwater samples. No TPH, VOCs, SVOCs, pesticides, herbicides, PCBs, or metals were detected in the surface water sample at concentrations above applicable State MCLs or other water quality criteria as set forth in 10 CSR 20-7 (Water Quality Standards)

### 2.2.4 Sediments

Six sediment samples were collected from within the pond boundaries (Tetra Tech, 1995a). The samples were composites of four separate aliquots (equal-sized portions). The samples were subject to the same suite of analytical parameters as the water samples. Results showed that VOCs, metals, herbicides, pesticides, and PCBs were not detected above applicable MDNR STARC values in any sediment samples. However, diesel-range petroleum hydrocarbons were detected in three samples at concentrations above the applicable STARC values.

Reported TPH concentrations in the sediments ranged from 115 ppm to 935 ppm. In addition, PAH compounds were found in the sediment samples, with total polyaromatic hydrocarbons (PAH) concentrations ranging from 6 ppm to 102 ppm. The State STARC values for individual PAH compounds range between 0.23 ppm for benzo(a)pyrene and 52 ppm for chrysene. Benzo(b)fluoranthene was detected in five sediment samples at concentrations above the State  $C_{ID1}$  of 1.4 ppm.

## 2.3 Objectives and Scope

The objectives of the site investigation at AOC 002 are as follows:

- assess extent of potential COC in surface water
- assess extent of potential COC in sediment
- assess presence of COC in an existing groundwater monitoring well

To meet these objectives, the following field activities will be performed at AOC 002:

- collect three surface water samples
- collect eight sediment samples
- collect one groundwater sample from the existing monitoring well
- analyze surface water, sediment, and groundwater samples for VOCs, SVOCs, TPH, metals, and PCBs

If COC in any of the surface water, sediment, or groundwater samples are found at concentrations exceeding action levels, then the scope of work will be expanded to satisfy the following additional objectives:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater

If necessary, a Phase 2 investigation will be performed at AOC 002 to meet the objectives listed above. The following tasks will be conducted during the Phase 2 investigation:

- install two monitoring wells
- collect four soil samples
- measure groundwater elevations in all three wells
- collect three groundwater samples
- analyze soil and groundwater samples for VOCs, SVOCs, TPH, metals, and PCBs

### 2.3.1 Field Methodologies

The field and analytical methodologies to be used at AOC 002 are summarized below

#### 2.3.1.1 Monitoring Well Installation

Should a Phase 2 investigation be necessary, two new monitoring wells will be installed at AOC 002. Each well will be drilled between 6 and 18 inches into the upper bedrock unit. The proposed well locations are shown in **Figure A.6**. Monitoring well locations may be modified during the Basewide RI, depending on the location of underground utilities. The monitoring wells will be installed and developed according to the procedures described in the FSP.

#### 2.3.1.2 Groundwater Sampling

During the Phase 1 investigation, one groundwater sample will be collected from the existing monitoring well. If the Phase 2 investigation is performed, groundwater samples will be

collected from the existing monitoring well and from the two new monitoring wells. Water level measurements will be made before samples are collected. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs, SVOCs, TPH, metals, and PCBs.

### 2.3.1.3 Soil Sampling

Soil samples will only be collected if a Phase 2 investigation is warranted. The samples will be collected during the drilling of monitoring well borings. Each boring will be continuously sampled from the surface to completion. Two soil samples from each well boring will be retained for laboratory analyses. At each boring, one soil sample will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. The second sample shall be collected from a depth interval immediately above the water table elevation.

### 2.3.1.4 Surface Water Sampling

If the pond has water, three surface water samples will be collected during the Phase 1 investigation. If surface water is not initially present, an effort will be made to collect samples after it rains. Surface water sampling locations are shown in **Figure A.6**. Samples will be collected according to the procedures stated in the FSP and analyzed for VOCs, SVOCs, TPH, metals, and PCBs.

### 2.3.1.5 Sediment Sampling

During the Phase 1 investigation, a total of eight sediment samples will be collected at AOC 002. The sampling locations are shown in **Figure A.6**. At locations inside the drainage pond, a shallow and deep sediment sample shall be collected, respectively, from 0 to 6 inches below ground surface (bgs) and from 12 to 18 inches bgs. One sediment sample will also be collected from both the influent bypass outfall and from the french drain outfall. Samples will be collected according to the procedures specified in the FSP, and they will be analyzed for VOCs, SVOCs, TPH, metals, and PCBs.

## 2.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at AOC 002 to provide quality control. The following QA/QC samples will be collected during the Phase 1 investigation:

- one duplicate surface water sample
- one duplicate sediment sample
- one duplicate groundwater sample

The following QA/QC samples will be collected during the Phase 2 investigation:

- one duplicate soil sample
- one duplicate groundwater sample

In addition to field duplicates, other QA/QC samples may be collected during the Phase 1 and Phase 2 investigations at AOC 002. These samples may include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

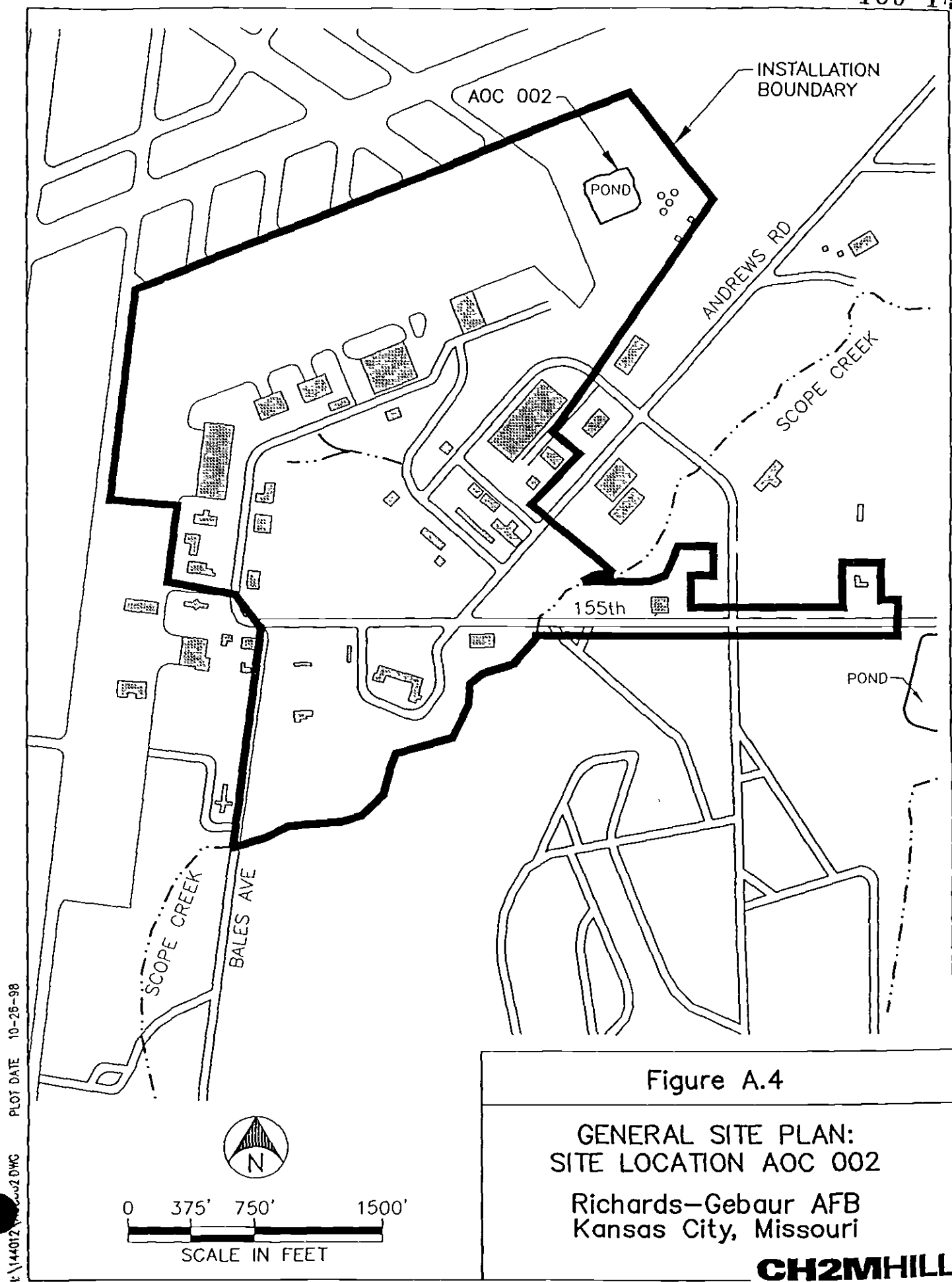
### 2.3.3 Laboratory Analyses

**Table A-2** lists the analytical parameters for soil, groundwater, surface water, sediment and associated QC samples.

**Table A-2 Summary of Sample Analyses - AOC 002**

PHASE 1 INVESTIGATION						
Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater	1	√	√	√	√	√
Sediment (Shallow)	5	√	√	√	√	√
Sediment (Deep)	3	√	√	√	√	√
Surface Water	3	√	√	√	√	√
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicates <sup>2</sup>	3	√	√	√	√	√
<b>Notes.</b> 1. In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP. 2. At least one field duplicate shall be collected for each sample medium.						

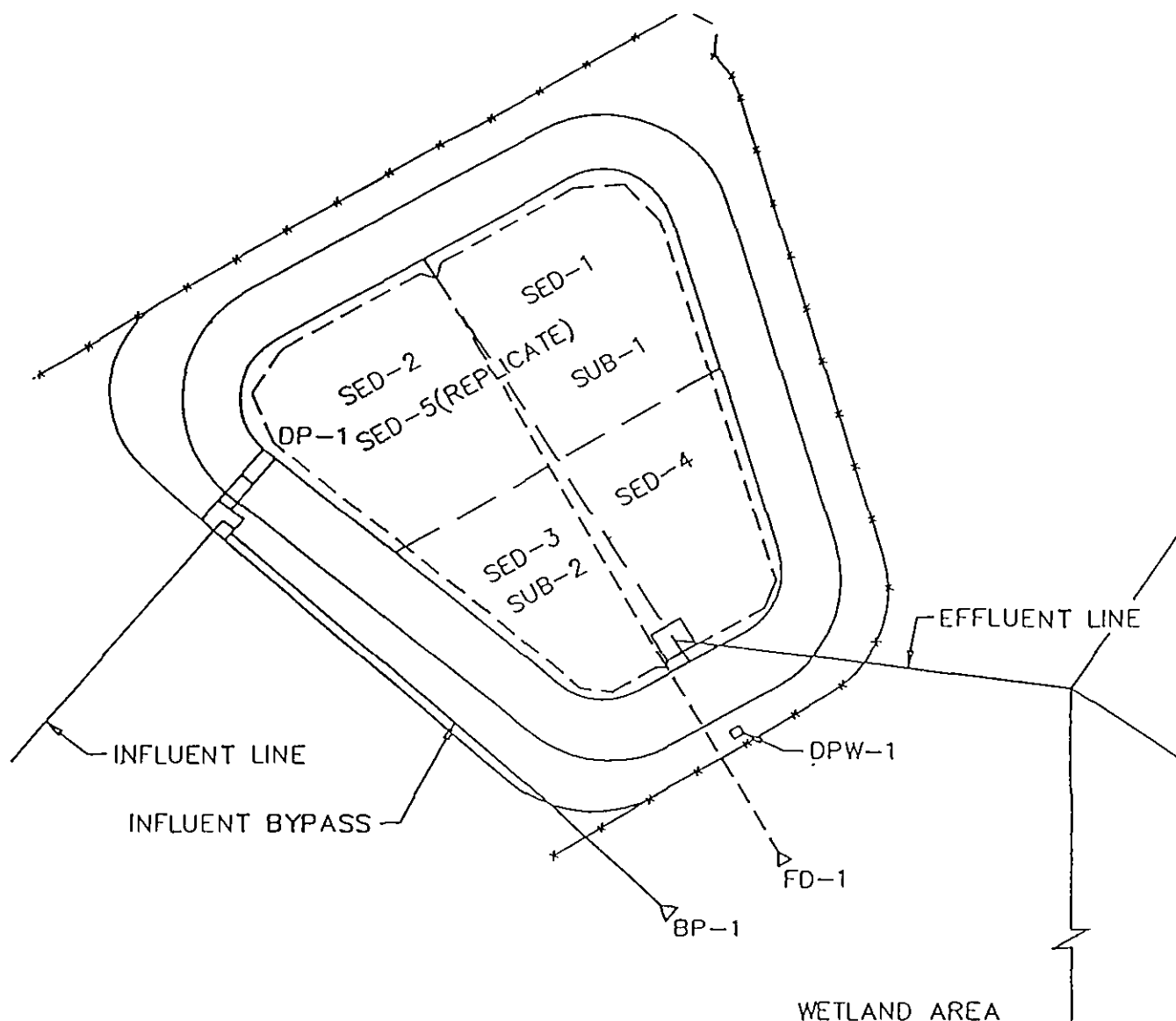
PHASE 2 INVESTIGATION						
Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Sample</b>						
Groundwater	3	√	√	√	√	√
Soil	4	√	√	√	√	√
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicates <sup>2</sup>	2	√	√	√	√	√
<b>Notes</b> 1. In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP. 2. At least one field duplicate shall be collected for each sample medium.						



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SED = SEDIMENT SAMPLES AT A DEPTH OF 0-2 INCHES

BP = SEDIMENT SAMPLE COLLECTED FROM BYPASS OUTFALL.

SUB = SEDIMENT SAMPLE COLLECTED AT A DEPTH OF 6-8 INCHES

DPW = GROUNDWATER MONITORING WELL.

FD = SURFACE WATER SAMPLE COLLECTED AT THE OUTFALL AT THE TRECH DRAIN

DP = SURFACE WATER SAMPLE COLLECTED FROM THE OUTFALL.

OIL/WATER  
SEPARATOR  
(9470B)



NOT TO SCALE

Figure A.5

SOIL AND SURFACE WATER  
SAMPLING LOCATIONS  
SITE AOC 002

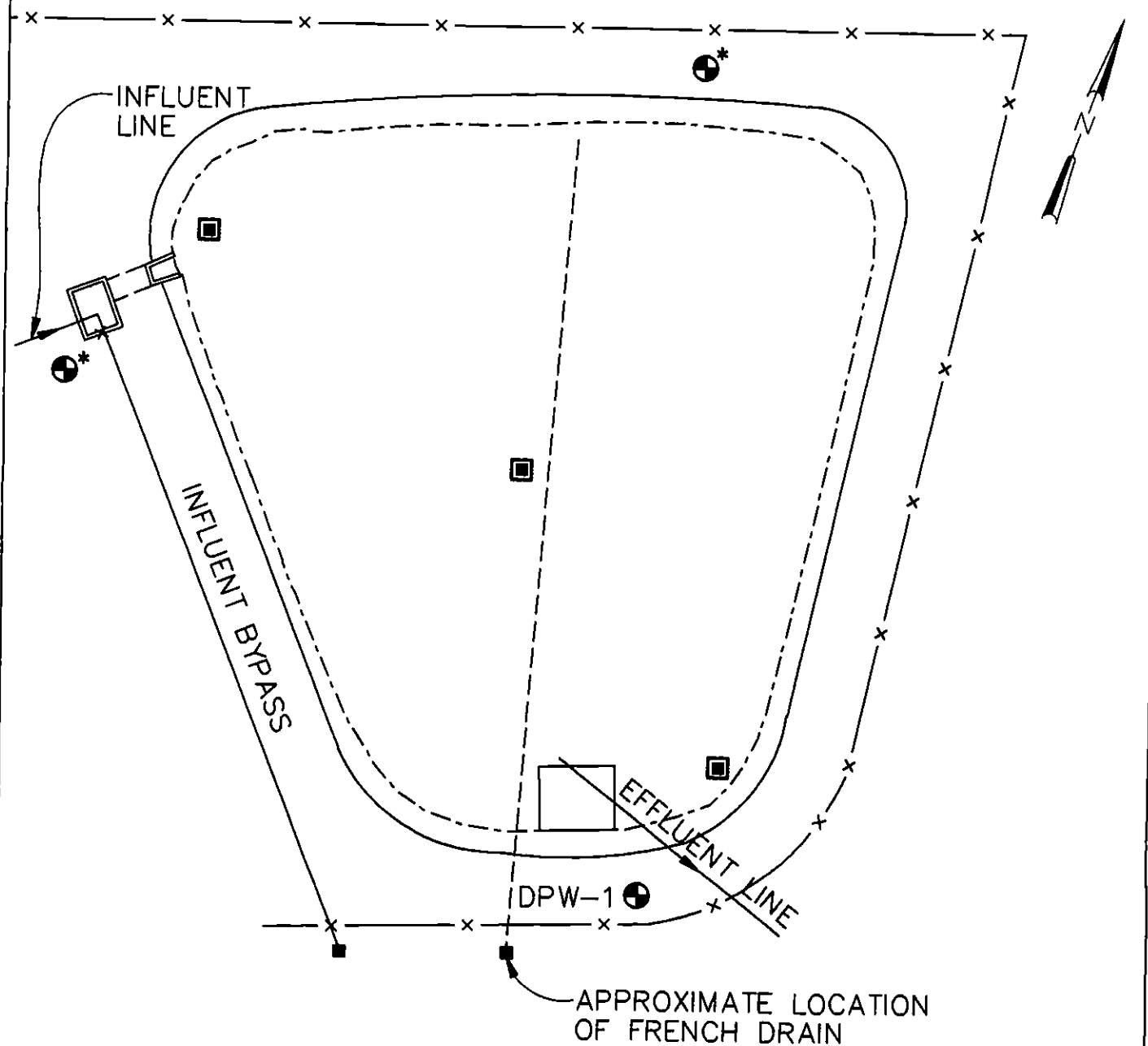
Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

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\*TO BE INSTALLED IF SURFACE WATER/SEDIMENT INDICATES CONTAMINATION.

Figure A.6

SITE AOC-002  
NORTH DRAINAGE POND  
PROPOSED SAMPLING LOCATIONS  
Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

## 3.0 SSP – AOC 003

### Firing Range

---

#### 3.1 Introduction

This site sampling plan describes the proposed sampling approach at AOC 003. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

##### 3.1.1 Site Description

AOC 003, the former small arms Firing Range, is located approximately 1,000 feet east of Andrews Road in the northeast portion of Richards-Gebaur AFB (**Figure A.7**). The site was constructed in 1956 and occupies approximately 2,300 square feet of ground, including a small magazine storage shed (USAF, 1993). The Firing Range berm was divided between machine gun use and rifle/pistol use. The berm is about 20 feet high and about 100 feet wide.

Improvements to the Firing Range's berm were made in 1988. The improvements included removing and replacing soil at the face of the berm, increasing the height of the berm, and adding a bullet deflector to the top of the berm. In 1990, further earthwork was performed to correct a sloughing problem at the face of the berm (Burns & McDonnell, 1993a and 1993c). The area behind the berm corresponds to part of an adjacent skeet shooting range. Since 1981, the skeet range has been owned by Kansas City. Because the area is outside of Air Force-owned property, all Air Force sampling results from this area have been reported to the Kansas City Aviation Department for their review and action, and the skeet range will not be addressed during the Basewide Remedial Investigation.

##### 3.1.2 Summary of Previous Investigations

The Firing Range was initially assessed as part of a base-wide environmental study (Ecology and Environment, 1988). In 1993, a RI was performed to assess the nature and extent of site contamination (USAF, 1993). Soil, sediment and surface water samples were collected from the Firing Range and analyzed for copper, lead, and zinc (Burns & McDonnell, 1993a). In addition, a risk assessment was conducted to determine potential risks resulting from exposure to the site soils (Burns & McDonnell, 1993a).

The RI involved trenching the Firing Range berm to collect subsurface soil samples from within the berm structure; collecting surface soil samples from the site; and collecting surface water and sediment samples from the stormwater drainage ditch to the west and south of the site.

Sampling locations examined during the previous site investigations are displayed in **Figure A.8**.

### 3.1.3 Current Site Status

The site is currently closed and fenced. No public access is available.

## 3.2 Chemicals of Concern

The primary COC associated with the Firing Range site are metals that were routinely used in the manufacture of shot and other small arms munitions. A typical round of ammunition consists of a bullet or ball, a cartridge case that contains the propellant, and a cap with the ignition system. The bullets may come with or without a metal outer jacket. Lead or copper at the site could be attributable to the metal jackets. Copper and zinc could be released by the bullets (Burns & McDonnell, 1993a).

### 3.2.1 Soil

Twenty grab soil samples were collected from two trenches dug into the berm (Burns & McDonnell, 1993a). Thirteen composite soil samples, each comprised of about 6 to 8 separate aliquots, were taken from the Firing Range in front of the berm.

Copper concentrations detected in subsurface and surface soil samples ranged from 7.8 ppm to 97.8 ppm. These results are well below the corresponding current State STARC level of 3,100 ppm (Burns and McDonnell, 1993a). The reported geometric mean for copper in Missouri soils is 13 ppm with an observed range of 18 ppm to 640 ppm (Tidball, 1984).

Lead concentrations in the soil samples collected from within the site varied from 10.8 ppm to 541 ppm, with the greatest concentration found in a sample collected from within the Firing Range berm (Burns & McDonnell, 1993a). The geometric mean of lead levels in Missouri soils is 20 ppm, with an observed range of 10 ppm to 90 ppm for soils in Jackson and Cass Counties (Tidball, 1984).

Concentrations of zinc in surface and subsurface soil samples ranged from 23.6 ppm to 130 ppm (Burns & McDonnell, 1993a). These results are well below the current CALM  $C_{DI}$  of 53,000 ppm and  $C_{leach}$  of 73,600 ppm. The geometric mean of zinc concentrations in Missouri soils is 49 ppm with an observed range of 18 ppm to 640 ppm (Tidball, 1984).

### 3.2.2 Groundwater

No groundwater samples have been collected at the site.

### 3.2.3 Surface Water

Six surface water samples were collected at the site and analyzed for copper, lead, and zinc. Only lead was detected, found in one of six samples at a concentration of 23.5 ppb, which exceeds the MDNR MCL (15 ppb) and MDNR criteria for aquatic life protection against chronic lead exposure (9 ppb to 23 ppb). The surface water samples, however, were unfiltered and contained suspended sediment and other soil particles. Thus, the lead concentration may be biased high because of the tendency for lead to adsorb to clay particles.

### 3.2.4 Sediment

Six sediment samples were collected and analyzed for the three metals of interest. Copper concentrations ranged from 9 ppm to 18 ppm; lead concentrations ranged from 24 ppm to 202 ppm; and zinc concentrations ranged from 47 ppm to 878 ppm. None of the sediment sample concentrations exceeded applicable State STARC values.

## 3.3 Objectives and Scope

The objective of the site investigation at AOC 003 is as follows:

- assess occurrence of metals in surface water

To meet this objective, the following field activity will be performed at AOC 003:

- collect three surface water samples for filtered and unfiltered laboratory analysis of metals

### 3.3.1 Field Methodologies

The field and analytical methodologies to be used at AOC 003 are summarized below.

#### 3.3.1.1 Monitoring Well Installation

No monitoring wells will be installed at AOC 003 during the Basewide RI/FS.

#### 3.3.1.2 Groundwater Sampling

No groundwater samples will be collected at AOC 003 during the Basewide RI/FS.

#### 3.3.1.3 Soil Samples

No surface or subsurface soil samples will be collected at AOC 003 during the Basewide RI/FS.

#### 3.3.1.4 Surface Water Sampling

When water is present in the drainage ditch, three surface water samples will be collected from AOC 003 and analyzed for metals using filtered and unfiltered methods. If surface water is not initially present, an effort will be made to collect samples after it rains. Surface water sampling locations are displayed in **Figure A.9**. The surface water samples will be collected according to the procedures specified in the FSP.

#### 3.3.1.5 Sediment Sampling

No sediment samples will be collected at AOC 003 during the Basewide RI/FS.

### 3.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at AOC 003 to provide quality control. The following QA/QC samples will be collected during the Basewide RI/FS.

- one duplicate surface water sample

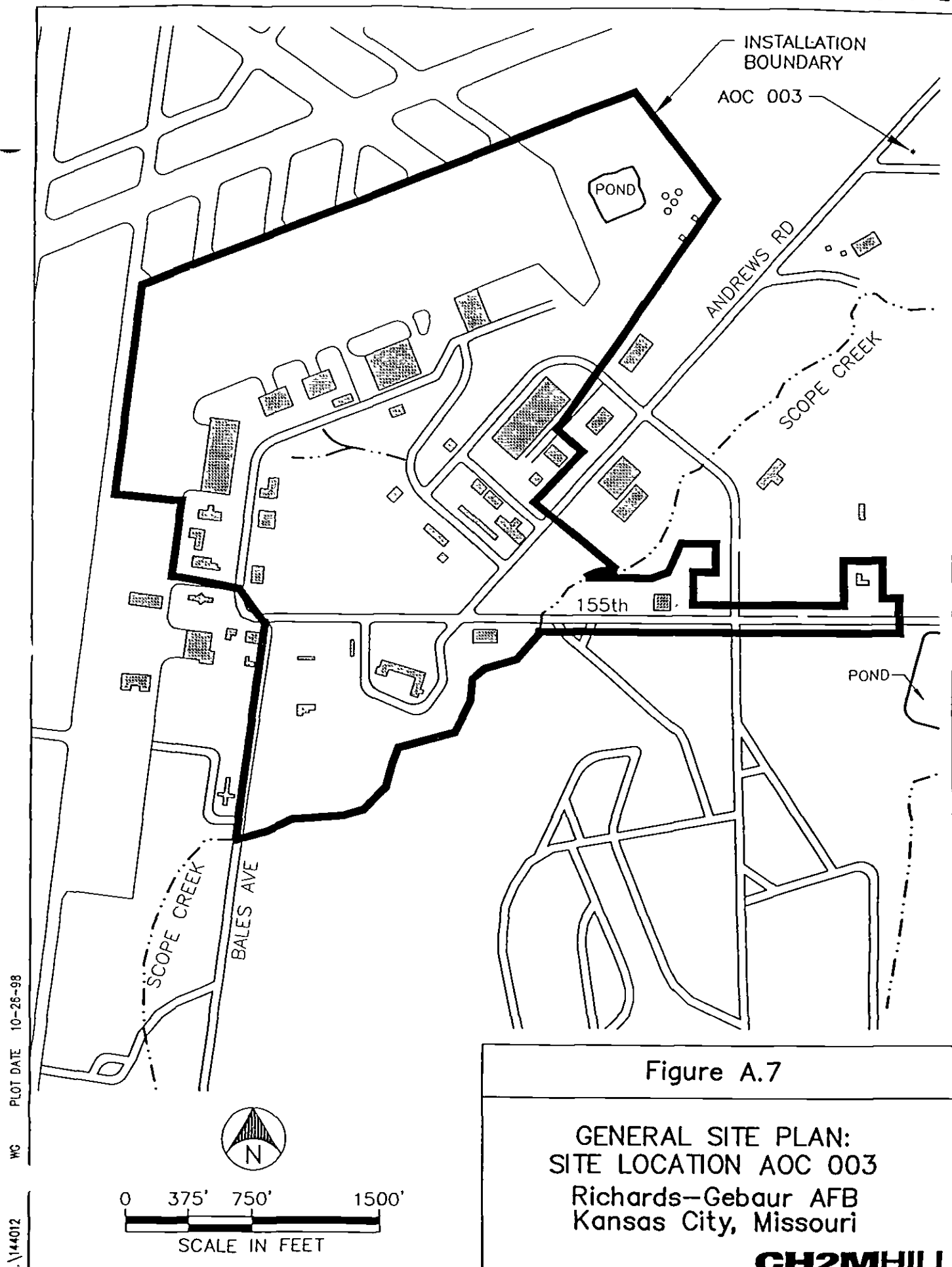
In addition to a field duplicate, other QA/QC samples may be collected during the site investigation at AOC 003. These samples may include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

### 3.3.3 Laboratory Analyses

**Table A-3** lists the analytical parameters for surface water and associated QC samples.

**Table A-3 Summary of Sample Analyses - AOC 003**

Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Surface Water	3				√	
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicates <sup>2</sup>	1				√	
<b>Notes</b> 1 In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP 2 At least one field duplicate shall be collected for each sample medium						



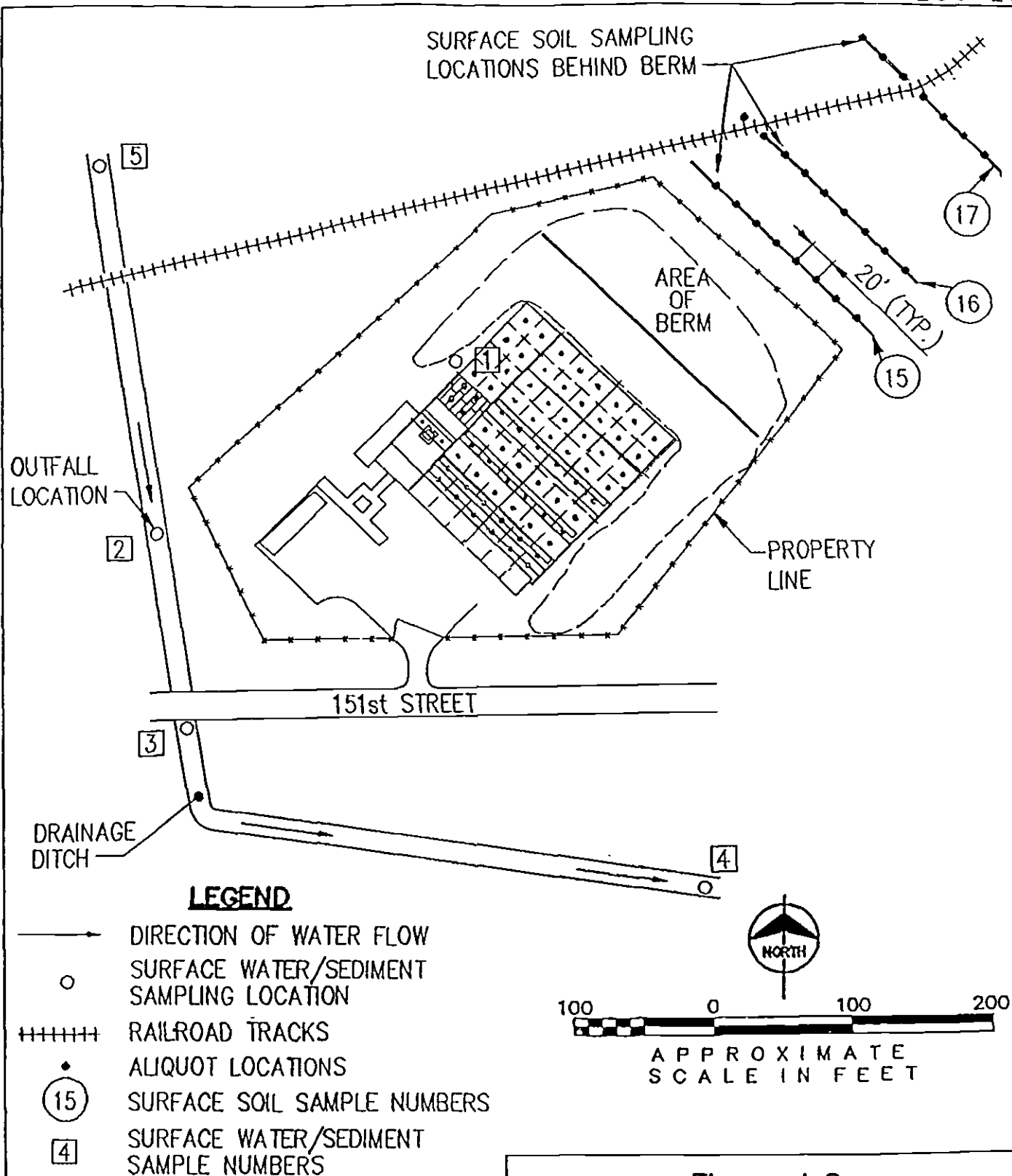


Figure A.8

SEDIMENT, SURFACE WATER AND  
COMPOSITE SURFACE SOIL  
SAMPLE LOCATIONS  
SITE AOC 003  
Richards-Gebaur AFB  
Kansas City, Missouri

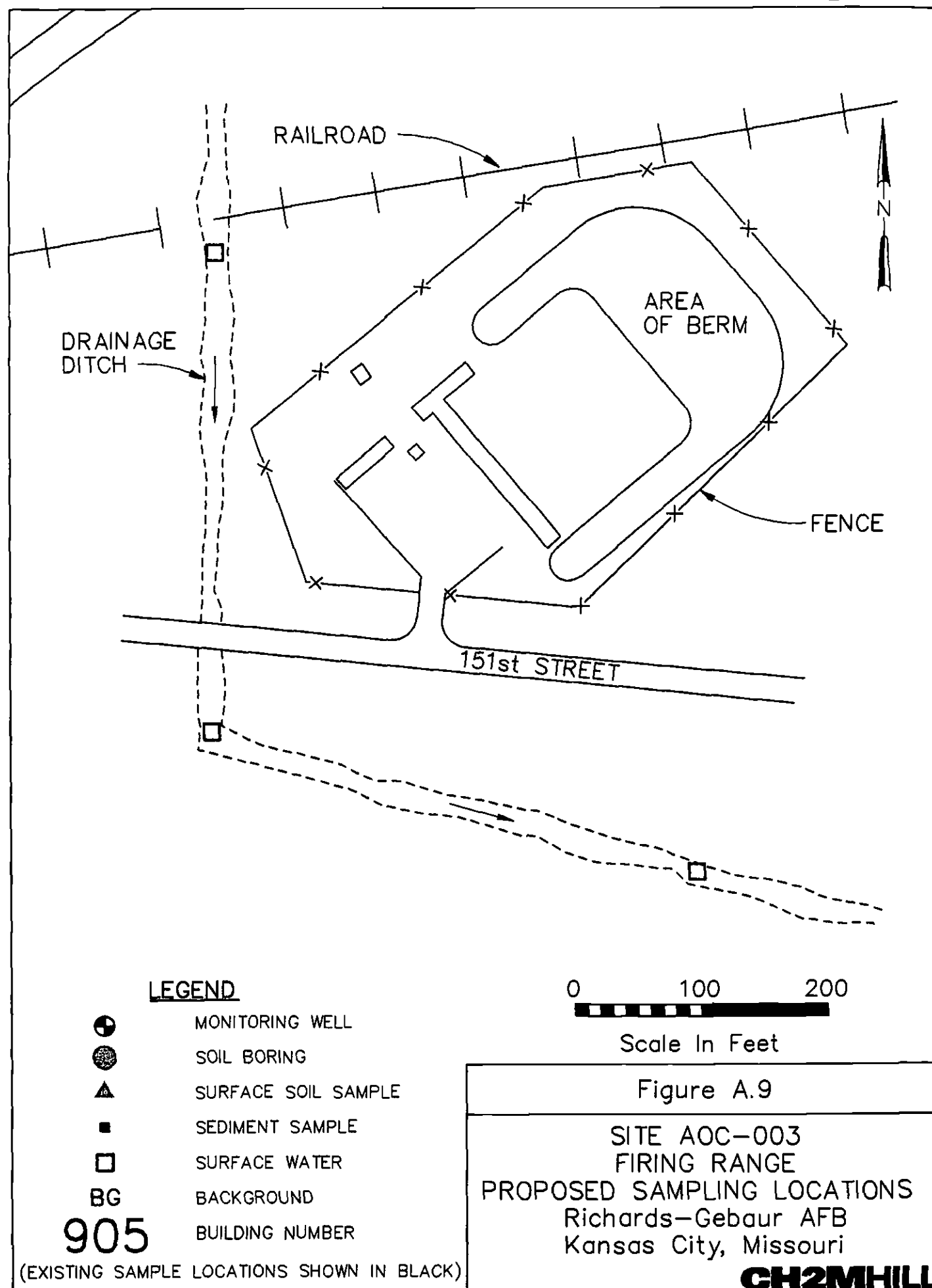
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## 4.0 SSP – AOC 010

### Building 918 Parking Lot

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#### 4.1 Introduction

This site sampling plan describes the proposed sampling approach at AOC 010. The objective of the sampling effort is to obtain the information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

##### 4.1.1 Site Description

AOC 010, known as the Building 918 Parking Lot, is located east of Building 918 along Hangar Road (**Figure A.10**). The site corresponds to a general area of undetermined size above the subsurface fuel hydrant line that passes beneath the paved parking lot in this part of the Base. AOC 010 is part of the former fuel hydrant system that delivered jet fuel from the POL Yard to the flightline fuel tanks. The site is paved, flat, and without vegetation. It is not located in a floodplain, and there are no surface water bodies or sediments at the site.

##### 4.1.2 Summary of Previous Investigation

AOC 010 was first identified during a 1992 soil gas survey of the fuel hydrant line. Elevated soil gas readings for total volatile hydrocarbons (TVH) were recorded at one location in the Building 918 Parking Lot area during the field screening survey (Burns and McDonnell, 1993f).

In 1996, the site was further investigated using soil borings and subsurface sampling (TappanAm, 1996). Three soil borings were drilled adjacent to the fuel hydrant line that passed beneath the parking lot to better examine subsurface conditions. One piezometer was installed in one of the borings. Seven soil samples were collected during the investigation.

Sampling locations examined during previous site investigations are displayed in **Figure A.11**.

##### 4.1.3 Current Site Status

No remedial actions have been deemed necessary at the Building 918 Parking Lot site. However, because groundwater quality has not been verified, site characterization is considered incomplete.

#### 4.2 Chemicals of Concern

Potential COC for the Building 918 Parking Lot site are those gasoline-range and diesel-range hydrocarbons routinely associated with jet fuel. Soil sampling has been performed to evaluate the extent and distribution of these chemicals at the site.

### 4.2.1 Soils

In 1992, a tracer soil gas survey of the underground fuel hydrant line reported concentrations of TVH constituents above ambient baseline values in the vicinity of the Building 918 Parking Lot (Burns & McDonnell, 1993f). The source of TVH contamination was thought to be migration of fuel vapors along the gravel lined hydrant trench from the fuel hydrant line leak that had occurred several hundred feet north near Building 942 and was discovered in 1993 (Dames & Moore, 1995).

In 1996, seven subsurface soil samples were collected and analyzed for TPH constituents and VOCs (TappanAm, 1996). No TPH constituents or VOCs were detected in any of the soil samples.

### 4.2.2 Groundwater

Groundwater was encountered in two of three soil borings drilled to about 20 feet below ground surface. A piezometer was installed in one of the borings and screened from 10 feet to 20 feet below ground surface. However, no groundwater samples were collected at the site because no soil contamination was found during the subsurface soil sampling investigation.

## 4.3 Objectives and Scope

The objective of the site investigation at AOC 010 is as follows:

- evaluate presence and concentration of potential COC in groundwater

To meet this objective, the following field activity will be performed at AOC 010:

- collect a groundwater sample from the existing piezometer
- analyze the groundwater sample for VOCs and TPH

### 4.3.1 Field Methodologies

The field and analytical methodologies to be used at AOC 010 are summarized below.

#### 4.3.1.1 Monitoring Well Installation

No monitoring wells will be installed at AOC 010 during the Basewide RI/FS.

#### 4.3.1.2 Groundwater Sampling

One groundwater sample will be collected from the existing piezometer, shown in **Figure A.12**. A water level measurement will be made in the piezometer before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs and TPH.

#### 4.3.1.3 Soil Sampling

No soil samples will be collected at AOC 010 during the Basewide RI/FS.

#### 4.3.1.4 Surface Water Sampling

No surface water samples will be collected at AOC 010 during the Basewide RI/FS.

#### 4.3.1.5 Sediment Sampling

No sediment samples will be collected at AOC 010 during the Basewide RI/FS.

#### 4.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at AOC 010 to provide quality control. The following QA/QC samples will be collected during the Basewide RI/FS:

- one duplicate groundwater sample

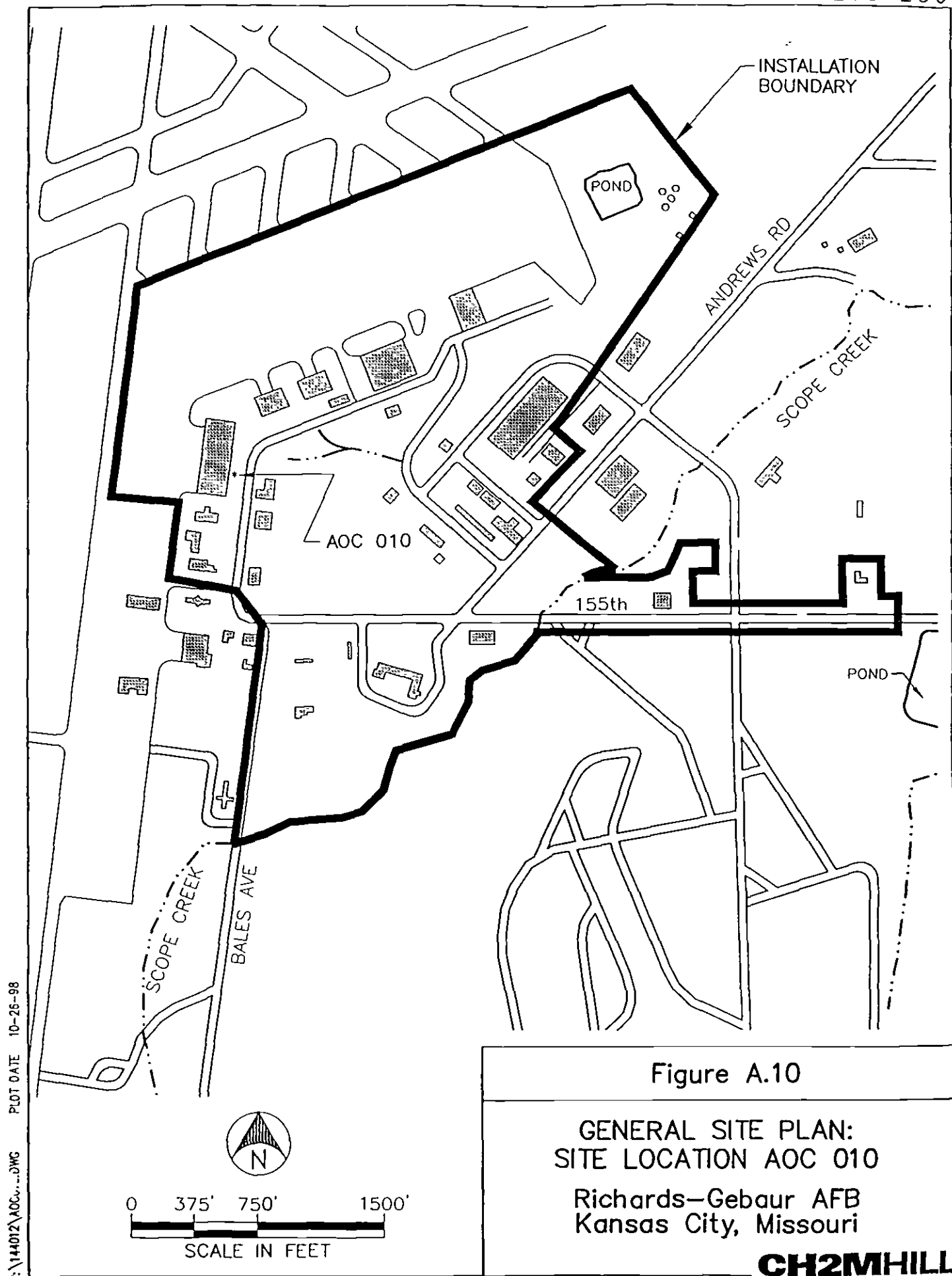
In addition to a field duplicate, other QA/QC samples may be collected during the Basewide RI/FS. These samples may include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

#### 4.3.3 Laboratory Analyses

**Table A-4** lists the analytical parameters for groundwater and associated QC samples.

**Table A-4 Summary of Sample Analyses - AOC 010**

Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater	1	√		√		
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicates <sup>2</sup>	1	√		√		
Notes						
1 In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP.						
2 At least one field duplicate shall be collected for each sample medium						



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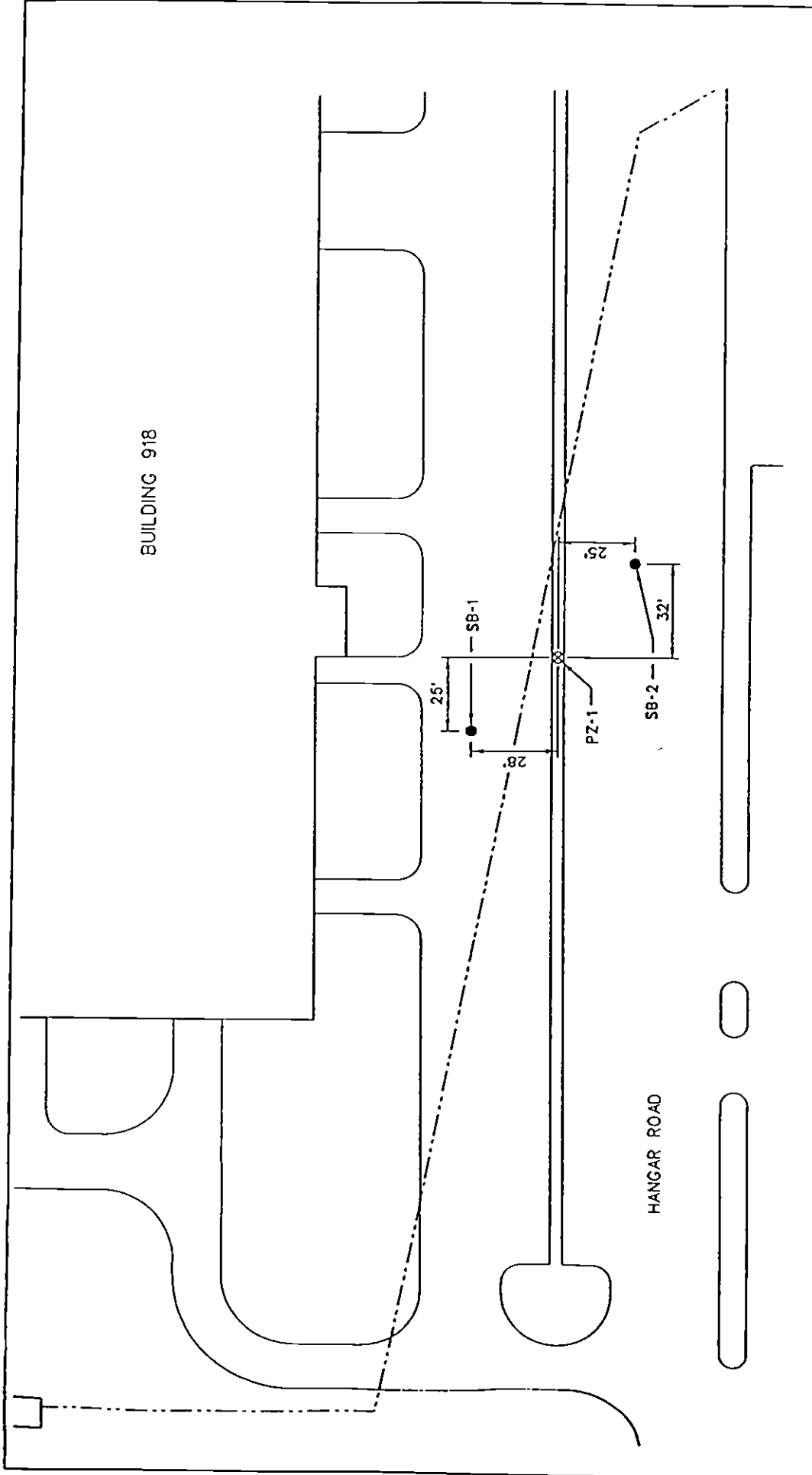


Figure A.11

PIEZOMETER AND SOIL BORING  
LOCATIONS  
SITE AOC 010  
Richards-Gebaur AFB  
Kansas City, Missouri

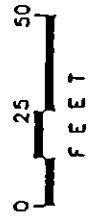
**CH2MHILL**

**LEGEND**

--- 8" JP-4 PIPELINE APPROXIMATE LOCATION

⊗ PIEZOMETER PZ-1

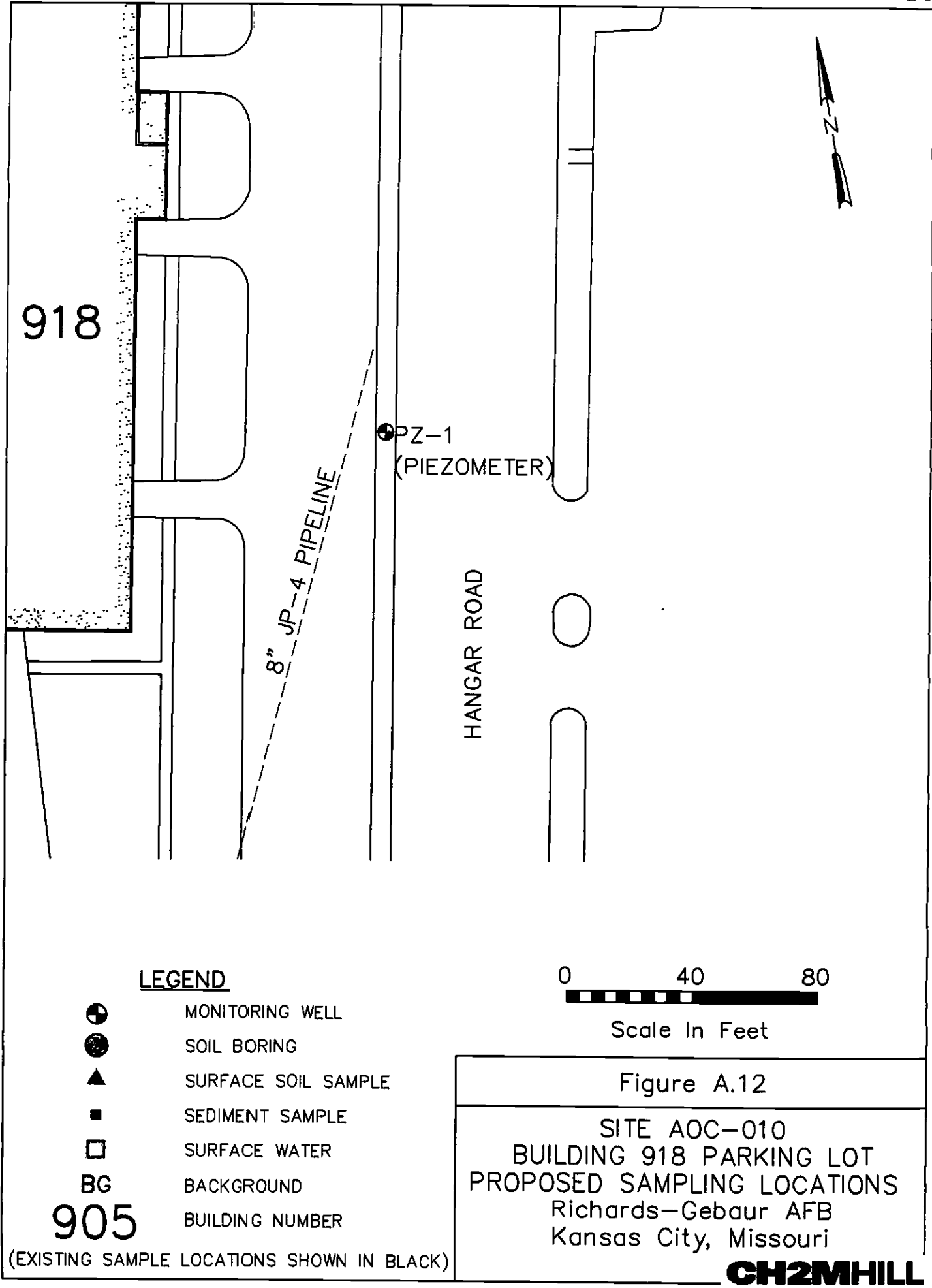
● SOIL BORING SB-1



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## 5.0 SSP – CS 001

### Fuel Line 942 Section

---

#### 5.1 Introduction

This site sampling plan describes the proposed sampling approach at CS 001. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

##### 5.1.1 Site Description

CS 001 designates the Fuel Line 942 Section. The site is located south of Hangar Road, approximately 50 feet north of Building 942 (**Figure A.13**). The site is approximately 230 feet long by 60 feet wide, according to site drawings. The area was previously contaminated by a leak from the former fuel hydrant line that transferred jet fuel from the POL Yard west to the flightline USTs. The fuel hydrant line in this area was formerly buried about eight feet below ground and passed parallel to the rear of Building 942. The fuel line was constructed in 1954 (USAF, 1993) and was used until the mid-1970s. The site is not located in a floodplain, and there are no surface water bodies near the site.

##### 5.1.2 Summary of Previous Investigations

The area designated CS 001 is related to the Fuel Hydrant Line. The pipeline connects the POL storage yard with the flightline fueling system (that included the former UST site known as ST 007). The fuel leak behind Building 942 was identified during a Hydrant Piping Study conducted in 1993 (Burns & McDonnell, 1993b). The study consisted of soil gas sampling and analysis at 20-foot linear intervals, and identified a probable leaking pipe section behind Building 942. In 1995, soil and groundwater samples were collected from the affected area (Dames & Moore, 1995). Following the site characterization activities, approximately 930 cubic yards of soil was removed from CS 001 (Dames & Moore, 1995).

Sampling locations examined during previous site investigations are displayed in **Figure A.14**.

##### 5.1.3 Current Site Status

According to the available data, the petroleum-contaminated soil has been successfully removed from the site. The excavation has been backfilled with clean soil from another location on-site. However, the extent of the current site characterization, particularly with regard to groundwater flow gradient and direction, appears incomplete. In addition, the potential for contamination to extend under Building 942 has not been investigated. Therefore, the site requires further action before site closeout status can be achieved.



## 5.2 Chemicals of Concern

COC at CS 001 are TPH constituents, including BTEX compounds. These chemicals are characteristic of petroleum fuel products. Soil and groundwater sampling has been performed to evaluate the extent and distribution of these chemicals at the site.

### 5.2.1 Soils

Twelve soil samples were collected from three monitoring well borings at CS 001 (Dames & Moore, 1995). A single soil boring provided another three samples for analysis. The samples were analyzed for TPH Gasoline Range Organics (GRO)/Diesel Range Organics (DRO) and BTEX constituents. Analytical results indicated low concentrations (12 ppm to 63 ppm) of TPH/DRO in the soil samples collected from 12 feet to 20 feet below ground surface. No BTEX compounds were detected in any samples with concentrations above applicable State guidelines.

Following the remedial excavation, seven post-excavation samples were collected from the excavation sidewalls and floor to ensure that petroleum impacted soils had been removed and that the removal action met MDNR requirements (Dames & Moore, 1995). The samples were analyzed for TPH and BTEX. No BTEX and TPH GRO/DRO constituents were detected in any of the samples.

### 5.2.2 Groundwater

Three groundwater monitoring wells were installed at the site to determine whether groundwater had been impacted by petroleum hydrocarbons released from the fuel hydrant line (Dames & Moore, 1995). The locations of the wells are shown in **Figure A.14**. Three groundwater samples were collected from the existing monitoring wells and analyzed for BTEX, TPH GRO/DRO, and lead. No BTEX and TPH GRO/DRO constituents were present in the samples at levels above laboratory detection limits. Lead was detected in one of the samples but at a concentration below applicable U.S. EPA Drinking Water Standards.

## 5.3 Objectives and Scope

The objectives of the site investigation at CS 001 are as follows:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- evaluate potential fuel contamination in soils under Building 942
- evaluate presence and concentration of COC in groundwater

To meet these objectives, the following field activities will be performed at CS 001:

- collect nine soil samples from three soil borings
- depending upon field conditions observed in the three borings, potentially collect three additional soil samples from a fourth soil boring
- install one new monitoring well
- collect one soil sample from the monitoring well boring
- measure groundwater elevations at existing and new monitoring wells
- collect groundwater samples from one new and three existing monitoring wells
- analyze soil and groundwater samples for VOCs and TPH

### 5.3.1 Field Methodologies

The field and analytical methodologies to be used at CS 001 are summarized below.

#### 5.3.1.1 Monitoring Well Installation

One new monitoring well will be installed at CS 001. The well will be drilled between 6 and 18 inches into the upper bedrock unit. As shown in **Figure A.15**, the well will be located west of the area excavated in 1995. The location of this monitoring well may be modified during the Basewide RI, depending on the location of underground utilities. The monitoring well will be installed and developed according to the procedures described in the FSP.

#### 5.3.1.2 Groundwater Sampling

Groundwater samples will be collected from the one new and three existing monitoring wells at CS 001. Monitoring well locations are shown in **Figure A.15**. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs and TPH.

#### 5.3.1.3 Soil Sampling

Three soil borings will be drilled along the north and west walls of Building 942 to investigate whether soil immediately next to the building was contaminated by leaks from the former fuel hydrant line. Soil boring locations are shown in **Figure A.15**. The borings will be advanced to a minimum of 15 feet below ground surface. If contamination is present at 15 feet bgs, the borings will proceed until five feet of uncontaminated soil is logged. At each boring, three samples will be retained for laboratory analyses. Samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. If evidence of soil contamination is observed in the three borings, a fourth boring, shown in **Figure A.15**, may be completed at CS 001. Three soil samples shall be retained from the fourth boring, following the same selection procedure described for the previous three samples. One soil sample from the monitoring well boring will be retained for laboratory analysis, based upon the results of field screening and at the discretion of the field geologist. Selected samples will be analyzed for VOCs and TPH.

#### 5.3.1.4 Surface Water Sampling

No surface water samples will be collected from CS 001 during the Basewide RI/FS.

#### 5.3.1.5 Sediment Sampling

No sediment samples will be collected from CS 001 during the Basewide RI/FS.

### 5.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at CS 001 to provide quality control. The following QA/QC samples will be collected during the investigation at CS 001:

- one duplicate groundwater sample
- one duplicate soil sample
- a second duplicate soil sample, if a fourth soil boring is completed at CS 001

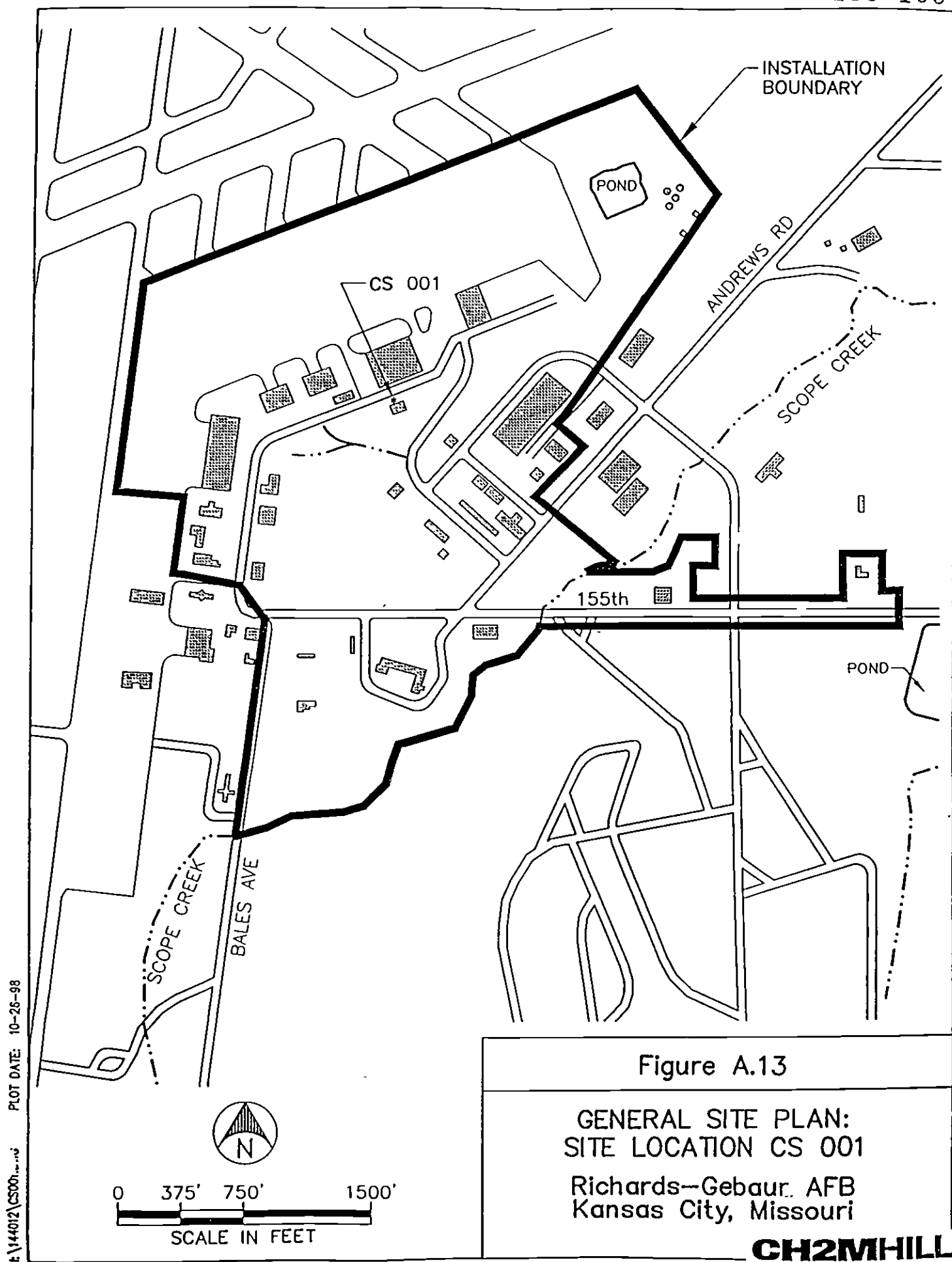
In addition to field duplicates, other QA/QC samples may be collected during the investigation at CS 001. These samples may include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

### 5.3.3 Laboratory Analyses

**Table A-5** lists the analytical parameters for soil, groundwater, and associated QC samples.

**Table A-5 Summary of Sample Analyses - CS 001**

Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater	4	√		√		
Soil	13 <sup>1</sup>	√		√		
<b>QA/QC Samples<sup>2</sup></b>						
Field Duplicates <sup>3</sup>	3	√		√		
Notes						
1 Three of these samples are contingent on field observations from previous soil samples collected during this RI						
2 In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP						
3 At least one field duplicate shall be collected for each sample medium						



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PLOT DATE 10-26-98

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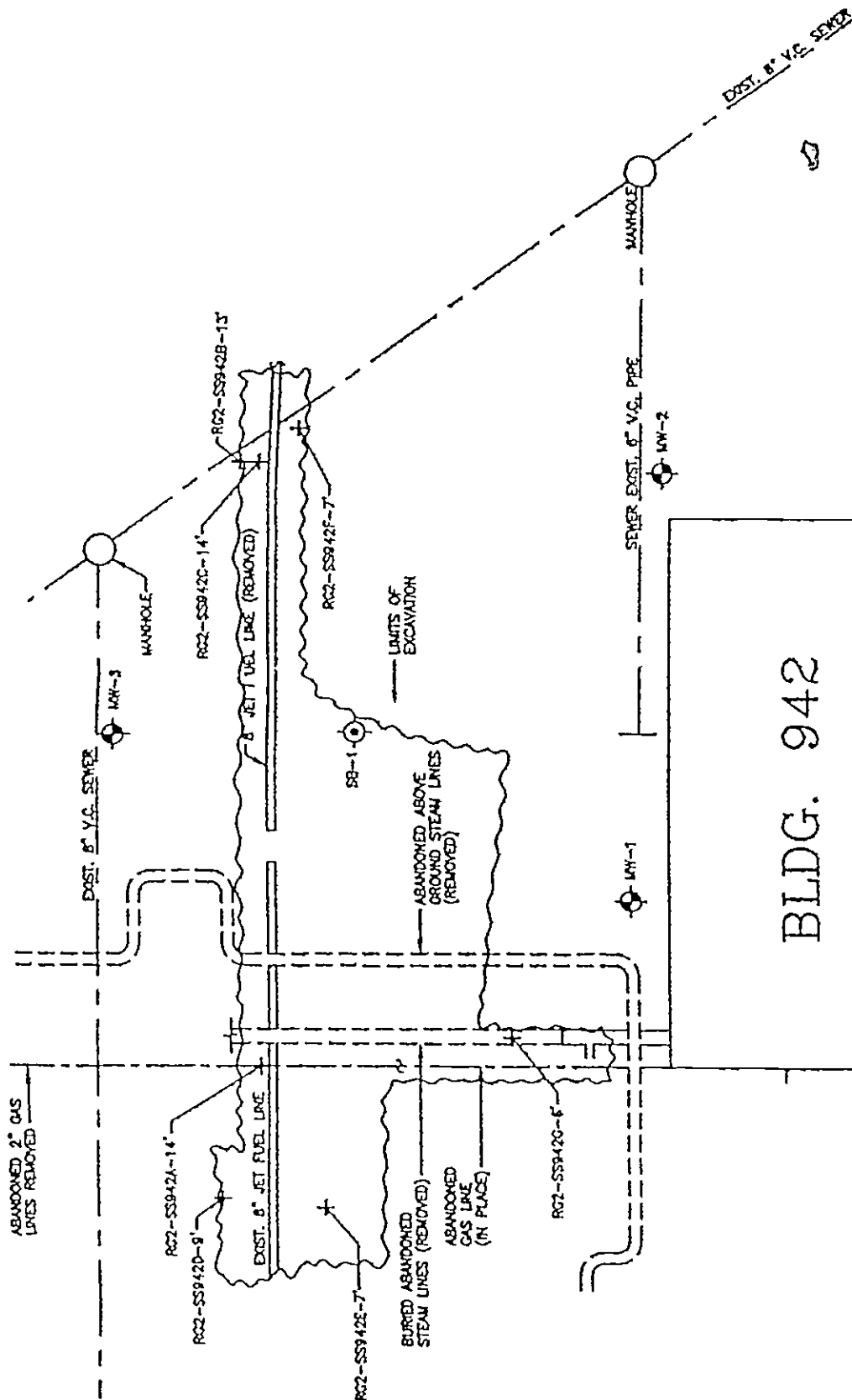


Figure A.14

SITE LAYOUT/SAMPLE LOCATIONS  
SITE LOCATION CS 001  
Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

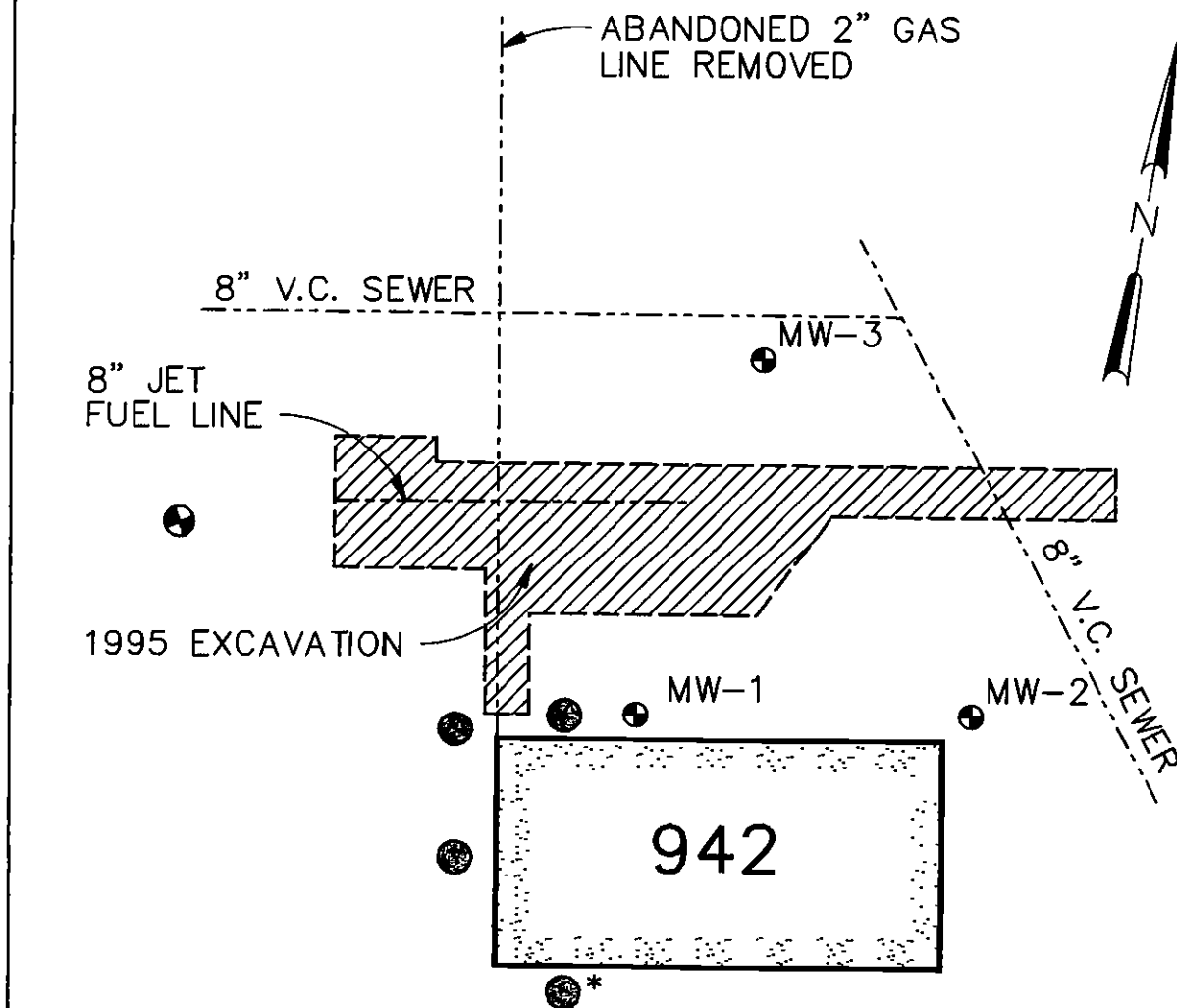


10' 20' 40'  
SCALE IN FEET

PLOT TIME: 15:36:08

PLOT DATE: 25-OCT-1999

FILENAME: 3673c05d.dlv



\*TO BE DRILLED IF OTHER SOIL BORINGS INDICATE CONTAMINATION.

### LEGEND

- MONITORING WELL
- SOIL BORING
- SURFACE SOIL SAMPLE
- SEDIMENT SAMPLE
- SURFACE WATER
- BACKGROUND
- BUILDING NUMBER

905

(EXISTING SAMPLE LOCATIONS SHOWN IN BLACK)

0 30 60

Scale In Feet

Figure A.15

SITE CS-001  
FUEL LINE-942 SECTION  
PROPOSED SAMPLING LOCATIONS  
Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

## 6.0 SSP – CS 002

# Oil/Water Separator at Building 704

---

### 6.1 Introduction

This site sampling plan describes the proposed sampling approach at CS 002. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

#### 6.1.1 Site Description

CS 002, the OWS at Building 704, is located south of 155<sup>th</sup> Street and east of Bales Avenue on the northeast corner of Building 704 (**Figure A.16**). The site is generally flat and occupies approximately 1,200 square feet. It is paved and without vegetation. The site is not located in a floodplain, and no surface water bodies or sediments exist onsite.

The area designated CS 002 contained a 500-gallon OWS and an associated 250-gallon holding tank used to store vehicle wash-water. The OWS was replaced in 1975, and the wash-water holding tank was replaced in 1989. In 1994, the two tanks were replaced once again, using the original location. The tanks are currently used by the US Marine Corps.

#### 6.1.2 Summary of Previous Investigations

The OWS and water holding tank were removed as part of an Air Force project to upgrade USTs at the Base. The OWS, holding tank, and 205 cubic yards of soil were removed in 1993 (Burns & McDonnell, 1994). The approximate limits of excavation are shown in **Figure A.17**. A groundwater assessment was conducted in June and July 1996 at the site, and two groundwater monitoring wells were installed to a depth of 25.5 feet below ground surface (Versar, 1996b). The locations of groundwater monitoring wells are shown in **Figure A.17**.

#### 6.1.3 Current Site Status

The original OWS and the water holding tank have been removed and replaced. The contaminated soil has been excavated and, according to the available data, the site has been successfully remediated. However, further site characterization is needed because the hydraulic gradient and direction of groundwater flow at the site has not been adequately defined.

## 6.2 Chemicals of Concern

The COC at the site are TPH constituents, VOCs, and metals. Soil and groundwater samples have been collected during previous investigations to evaluate the extent and distribution of the chemicals at the site.

### 6.2.1 Soils

Following the soil excavation, five post-excavation soil samples were collected and analyzed for TPH constituents, VOCs, and metals. Two of five soil samples from below the OWS contained TPH constituents at concentrations of 216 ppm and 349 ppm, greater than the applicable MDNR action level of 50 ppm. However, the concentrations are below the current MDNR CALM cleanup level of 500 ppm calculated for commercial site use. BTEX constituents were not detected at concentrations above the UST action levels. Other VOCs were not detected in the post-excavation samples at concentrations above the relevant CALM STARC levels. No metals were detected in the post-excavation samples at concentrations above applicable State guidelines.

### 6.2.2 Groundwater

Two groundwater samples were collected and analyzed for TPH constituents, BTEX, VOCs, and metals - filtered and unfiltered samples (Versar, 1996b). No TPH or BTEX compounds were detected in the samples. Other VOC constituents were also not detected in the well water samples. No metals were detected at concentrations exceeding applicable State action levels.

### 6.2.3 Surface Water and Sediments

No surface water or sediment samples were collected at the site

## 6.3 Objectives and Scope

The objectives of the site investigation at CS 002 are as follows:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater

To meet these objectives, the following field activities will be conducted at CS 002.

- install two monitoring wells
- measure groundwater elevations at the two new wells and one existing well
- collect groundwater samples from three monitoring wells
- collect one soil sample from each new monitoring well boring
- collect one soil sample from a boring completed within the area excavated in 1996
- analyze soil and groundwater samples for VOCs, TPH, and metals

### 6.3.1 Field Methodologies

The field and analytical methodologies to be used at CS 002 are summarized below.

#### 6.3.1.1 Monitoring Well Installation

Two new monitoring wells will be installed at CS 002. One of the wells will be installed in order to replace MW-2, which was potentially compromised when solvents were used to



open the well cap after the well had been mistakenly paved over with asphalt. Each well will be drilled between 8 and 16 inches into the upper bedrock unit. The proposed well locations are shown in **Figure A.18**. The monitoring well locations may be modified during the Basewide RI, depending on the location of underground utilities. The monitoring wells will be installed and developed according to the procedures described in the FSP.

#### **6.3.1.2 Groundwater Sampling**

Groundwater samples will be collected from the two new wells and the one existing well. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs, TPH, and metals.

#### **6.3.1.3 Soil Sampling**

Soil samples will be collected during the drilling of monitoring well borings. Each boring will be continuously sampled from the surface to completion. One soil sample from each boring will be retained for laboratory analyses. The samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. One soil sample shall be collected from a boring completed in the footprint of the 1996 excavation, in the area where a confirmation sample yielded 349 mg/kg of TPH. This soil sample will be collected one foot below the invert of the former UST. Soil samples retained for laboratory analyses will be tested for VOCs, TPH, and metals.

#### **6.3.1.4 Surface Water Sampling**

No surface water samples will be collected at CS 002 during the Basewide RI/FS.

#### **6.3.1.5 Sediment Sampling**

No sediment samples will be collected at CS 002 during the Basewide RI/FS.

### **6.3.2 Quality Assurance/Quality Control (QA/QC)**

In accordance with the project QAPP, additional samples will be collected at CS 002 to provide quality control. The following QA/QC samples will be collected during the site investigation at CS 002:

- one duplicate groundwater sample
- one duplicate soil sample

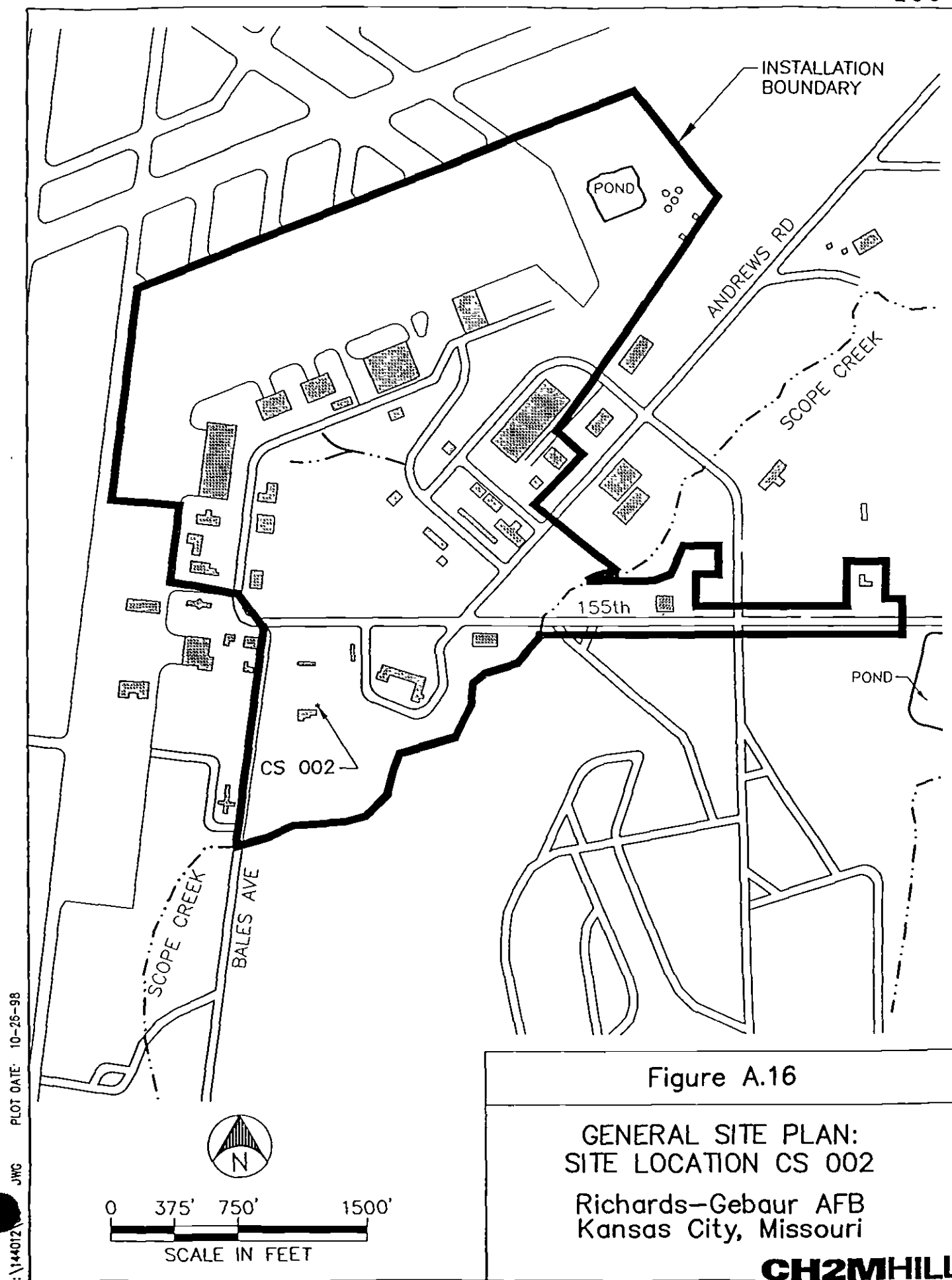
In addition to field duplicates, other QA/QC samples may be collected during the investigation at CS 002. These samples include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

### 6.3.3 Laboratory Analyses

**Table A-6** lists the analytical parameters for soil, groundwater, and associated QC samples.

**Table A-6 Summary of Sample Analyses - CS 002**

Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater	3	√		√	√	
Soil	3	√		√	√	
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicates <sup>2</sup>	2	√		√	√	
<b>Notes</b> 1. In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP. 2. At least one field duplicate shall be collected for each sample medium.						

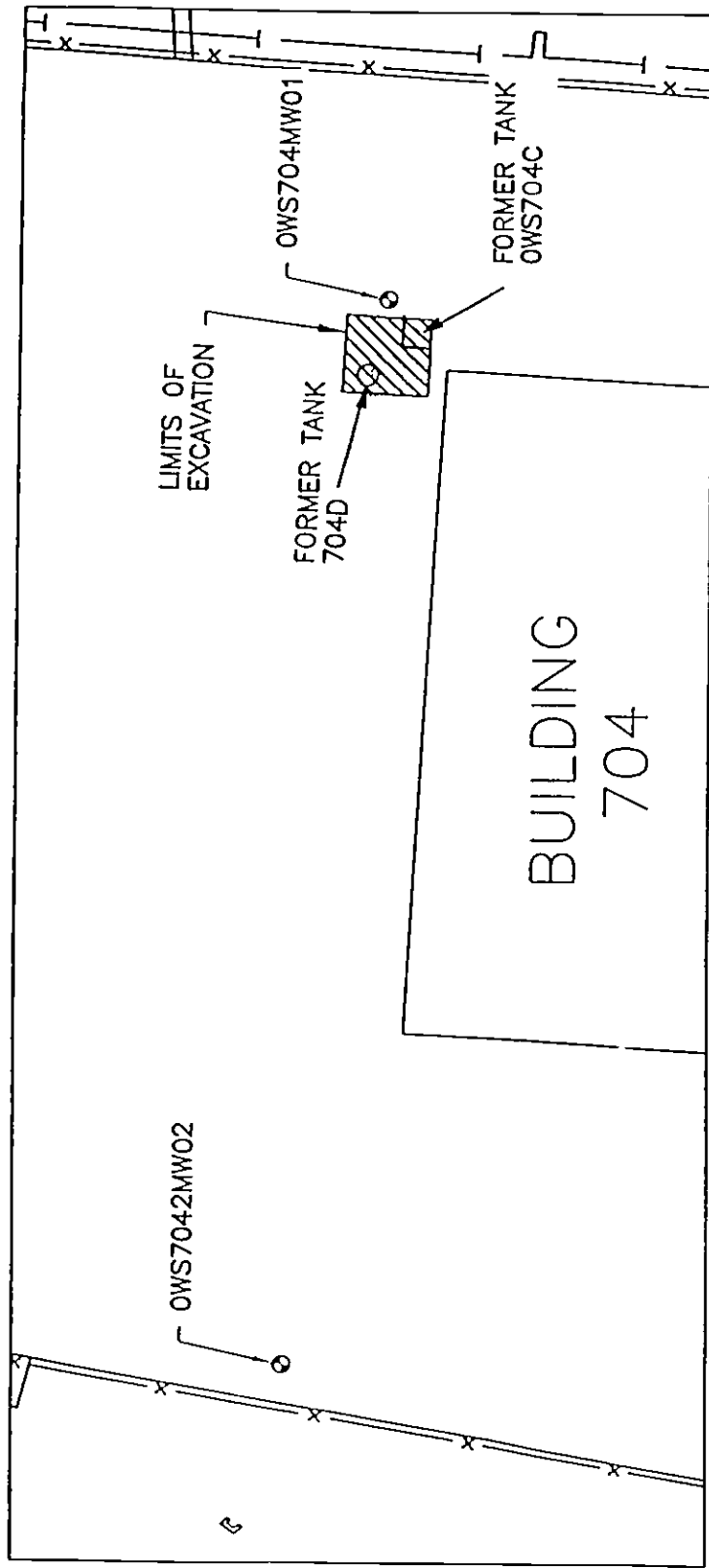


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JWC


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AFTER VERSAR INC., 1996



LEGEND

 LIMITS OF EXCAVATION

 GROUNDWATER MONITORING WELL

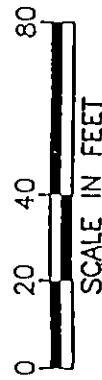


Figure A.17

GROUNDWATER MONITORING  
WELL LOCATION CS 002

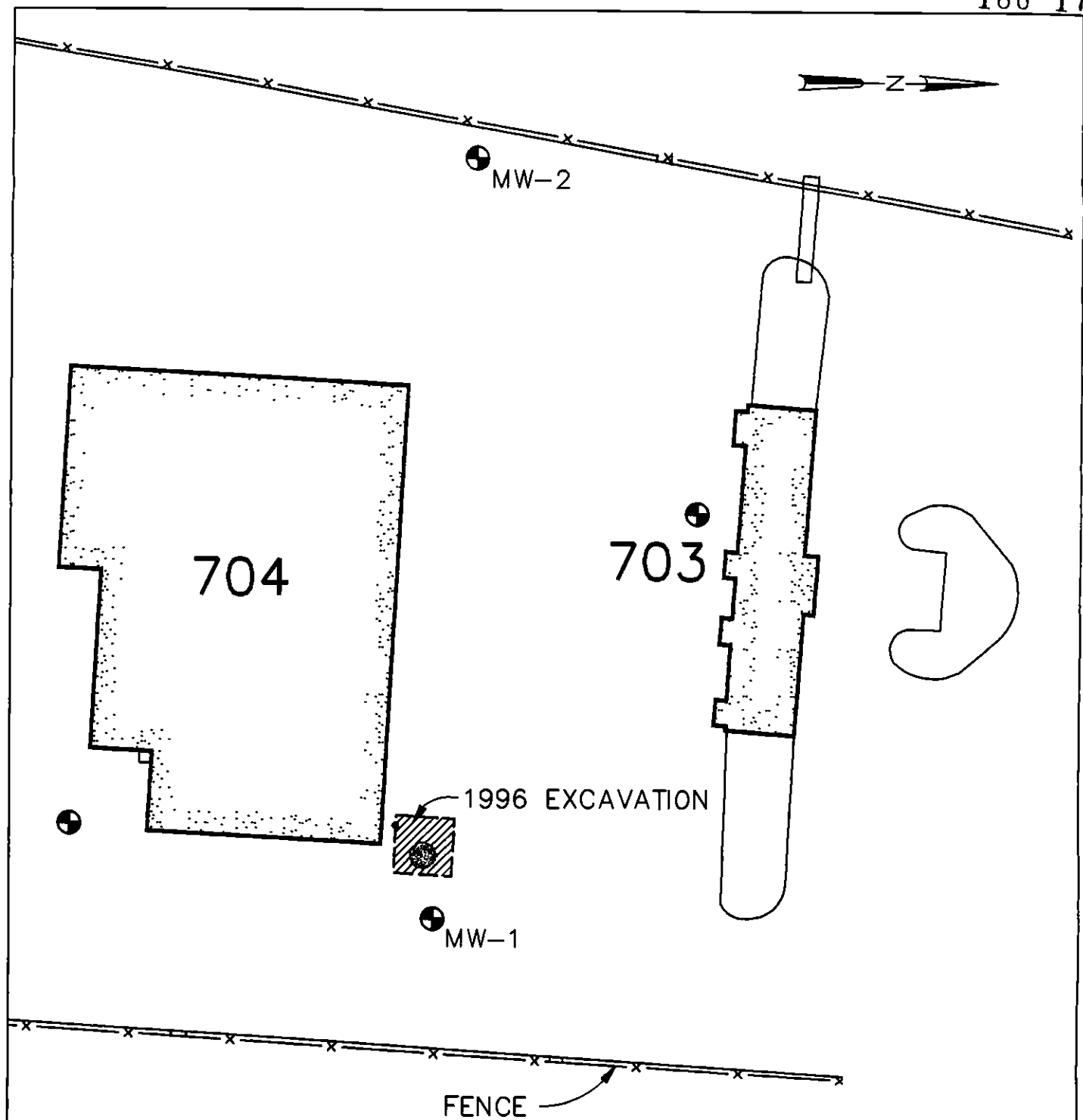
SITE LOCATION CS 002  
Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

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PLOT DATE: 25-OCT-1999

FILENAME: 3673c06d.dlv

**LEGEND**

MONITORING WELL



SOIL BORING



SURFACE SOIL SAMPLE



SEDIMENT SAMPLE



SURFACE WATER



BACKGROUND

905

BUILDING NUMBER

(EXISTING SAMPLE LOCATIONS SHOWN IN BLACK)

0 50 100

Scale In Feet

Figure A.18

SITE CS-002  
 O/W SEPARATOR AT BUILDING 704  
 PROPOSED SAMPLING LOCATIONS  
 Richards-Gebaur AFB  
 Kansas City, Missouri

**CH2MHILL**

## 7.0 SSP – CS 004

### UST 620A

---

#### 7.1 Introduction

This site sampling plan describes the proposed sampling approach at CS 004. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the Richards-Gebaur AFB ECS report (CH2M HILL, 1998).

##### 7.1.1 Site Description

CS 004 is the site of a former UST located at the northwest corner of Building 620 (**Figure A.19**). The UST was used to store waste liquids from Air Force fuel testing laboratories housed in Building 620 between 1966 and 1988. The capacity of the tank was 550 gallons. The composition of the net waste stream stored in this tank was estimated by Air Force personnel to be approximately 70% fuel, 28% water, and 2% acid (Esch, 1996). The site is about 400 square feet in area, flat, and unpaved. It is not located in a floodplain, and no surface water bodies or sediments are present onsite.

##### 7.1.2 Summary of Previous Investigations

As part of a 1988 Air Force project, the UST was removed. Low levels of TPH – 39 ppm (below MDNR's action level of 50 ppm) - were measured in a single soil sample collected from the excavation during the tank removal. Additional soil samples were collected in 1993 as part of the UST closure activities for the Base at large (Burns & McDonnell, 1994b). In order to confirm that the UST had been removed, and not abandoned in place as had been reported in a previous closure report, several more soil samples were collected in 1995. The investigation verified that the tank had indeed been removed, but soil sample analytical results indicated that the former UST area contained TPH constituent concentrations in soil above the applicable MDNR UST action level of 50 ppm. In response to the indications of residual soil contamination, about 500 cubic yards of soil was excavated in 1995 (Dames & Moore, 1996b). Three post-excavation soil samples were collected at this time. Two more soil samples were collected at the site to document subsurface conditions as part of a Subsurface Assessment in 1996 (HDB, 1996).

Best excavation sampling locations are displayed in **Figure A.20**

##### 7.1.3 Current Site Status

The UST at CS 004 has been removed. Based on the available data, the contaminated soil has been successfully excavated from the former UST area. The excavated area has been restored to its original condition. Potential impacts on shallow groundwater have not been addressed. It is recommended that further site characterization be conducted to assess groundwater quality. Because of the mixed nature of the tank contents, RCRA is a potential ARAR at CS 004.

## 7.2 Chemicals of Concern

Potential COC for CS 004 are those gasoline-range and diesel-range hydrocarbons routinely associated with jet fuel. Soil sampling has been performed to evaluate the extent and distribution of these chemicals at the site.

### 7.2.1 Soils

A single soil sample was collected from a depth of about 8.5 feet below ground surface during the tank removal. The sample was analyzed for TPH. The TPH concentration of 39 ppm was below the applicable State action level of 50 ppm.

In 1993, four soil borings were advanced at CS 004. One soil sample was collected for each boring at a depth of 9 feet below grade. The samples were analyzed for toxicity characteristic leaching procedure (TCLP) metals. The results were below the applicable RCRA guidelines for hazardous waste disposal (Burns and McDonnell, 1994b). However, the four borings were drilled on the south side of the site instead of around the former tank location (Esch, 1994) and thus potentially missed any contamination associated with the UST.

In 1995, a single composite soil sample was collected by backhoe from the former UST site at depths from 2 to 4 feet below grade. The sample was analyzed for TPH GRO/DRO; TCLP VOCs; BTEX constituents; TCLP SVOCs; and TCLP metals. No VOCs, SVOCs, BTEX, and metals were detected. However, the concentrations of GRO (160 ppm) and DRO (200 ppm) were detected above the State action level for TPH of 50 ppm, but below the current CALM STARC of 500 ppm for commercial land use.

Also in 1995, three post-excavation soil samples were collected from the excavation sidewalls and floor to verify the complete removal of the potentially petroleum-impacted soils. The samples were taken at depths of between 7 feet and 9.5 feet below ground surface and analyzed for BTEX, TPH GRO/DRO constituents, and priority pollutant metals. None of the analyzed compounds were detected above applicable MDNR action levels.

Two additional soil samples were collected in 1996 as part of a base-wide subsurface assessment of 20 UST Sites. The samples were collected from a depth of 15 feet and analyzed for TPH constituents, PAH compounds, and metals. No organic chemicals were detected above applicable State action levels. However, arsenic (21.7 ppm) and barium (8,490 ppm) were detected at levels above their respective MDNR STARC of 11 ppm and 3,930 ppm.

Considering the absence of hydrocarbon indicator chemicals, and the fact that arsenic and barium are not representative of the reported contents or use of the former UST at this location, the occurrence of low levels of arsenic and barium are considered to be natural events unrelated to past site operations.

### 7.2.2 Groundwater, Surface Water, and Sediments

No groundwater samples have been collected during site characterization or removal activities at CS 004. No surface water bodies or sediments are located at the site.

## 7.3 Objectives and Scope

The objectives of the site investigation at CS 004 are as follows:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater

To meet these objectives, the following field activities will be performed at CS 004:

- install three monitoring wells
- measure groundwater elevations in the three wells
- collect groundwater samples from each monitoring well
- collect one soil sample from each well boring
- analyze soil and groundwater samples for VOCs, SVOCs, TPH, and metals

### 7.3.1 Field Methodologies

The field and analytical methodologies to be used at CS 004 are summarized below.

#### 7.3.1.1 Monitoring Well Installation

Three new monitoring wells will be installed at CS 004. The wells will be drilled between 6 and 18 inches into the upper bedrock unit. The proposed well locations are shown in **Figure A.21**. The monitoring well locations may be modified during the Basewide RI, depending on the location of underground utilities. The monitoring wells will be installed and developed according to the procedures described in the FSP.

#### 7.3.1.2 Groundwater Sampling

Groundwater samples will be collected from each of the three new monitoring wells. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs, SVOCs, TPH, and metals.

#### 7.3.1.3 Soil Sampling

Soil samples will be collected during the drilling of monitoring well borings. Each boring will be continuously sampled from surface to completion. One sample from each boring will be retained for laboratory analysis. Soil samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. The samples will be analyzed for VOCs, SVOCs, TPH, and metals.

#### 7.3.1.4 Surface Water Sampling

No surface water samples will be collected from CS 004 during the Basewide RI/FS.

#### 7.2.1.5 Sediment Sampling

No sediment samples will be collected from CS 004 during the Basewide RI/FS.



### 7.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at CS 004 to provide quality control. The following QA/QC samples will be collected during the site investigation at CS 004:

- one duplicate groundwater sample
- one duplicate soil sample

In addition to field duplicates, other QA/QC samples may be collected during the site investigation at CS 004. These samples may include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

### 7.3.3 Laboratory Analyses

**Table A-7** lists the analytical parameters for soil, groundwater, and associated QC samples.

**Table A-7 Summary of Sample Analyses - CS 004**

Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater	3	√	√	√	√	
Soil	3	√	√	√	√	
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicates <sup>2</sup>	2	√	√	√	√	
Notes:						
1 In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP.						
2. At least one field duplicate shall be collected for each sample medium						

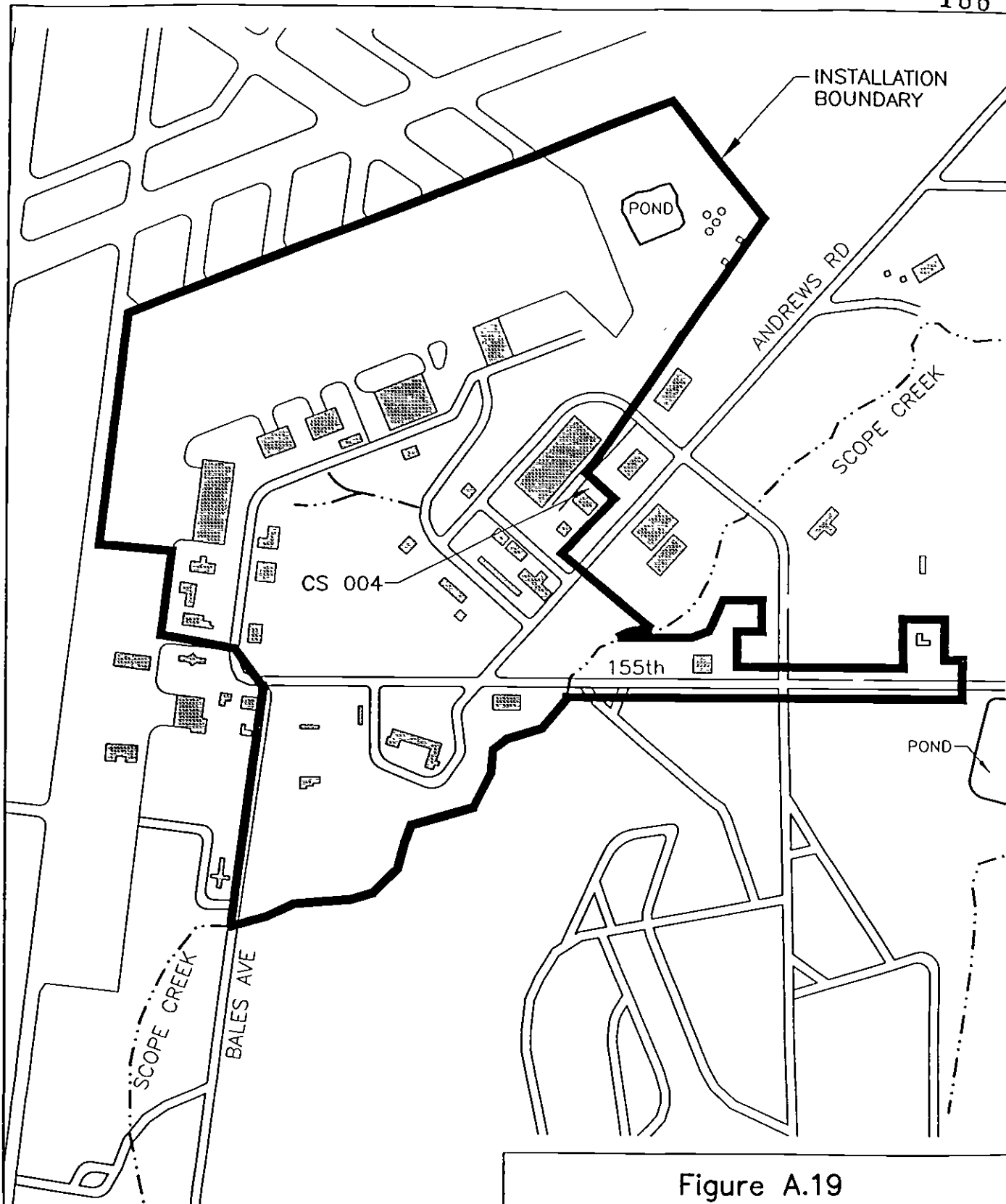


Figure A.19

GENERAL SITE PLAN:  
SITE LOCATION CS 004

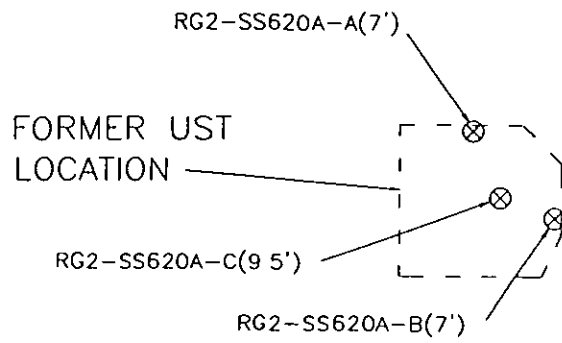
Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

PLOT DATE: 10-25-98

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AFTER VERSAR INC, 1996



BUILDING 620

ANDREWS ROAD

### LEGEND



SAMPLE LOCATION

RG2-SS620A-B(7')

SAMPLE NUMBER/DEPTH



EXTENT OF EXCAVATION

Figure A.20

POST EXCAVATION SAMPLE  
LOCATIONS:  
SITE CS 004  
Richards-Gebaur AFB  
Kansas City, Missouri

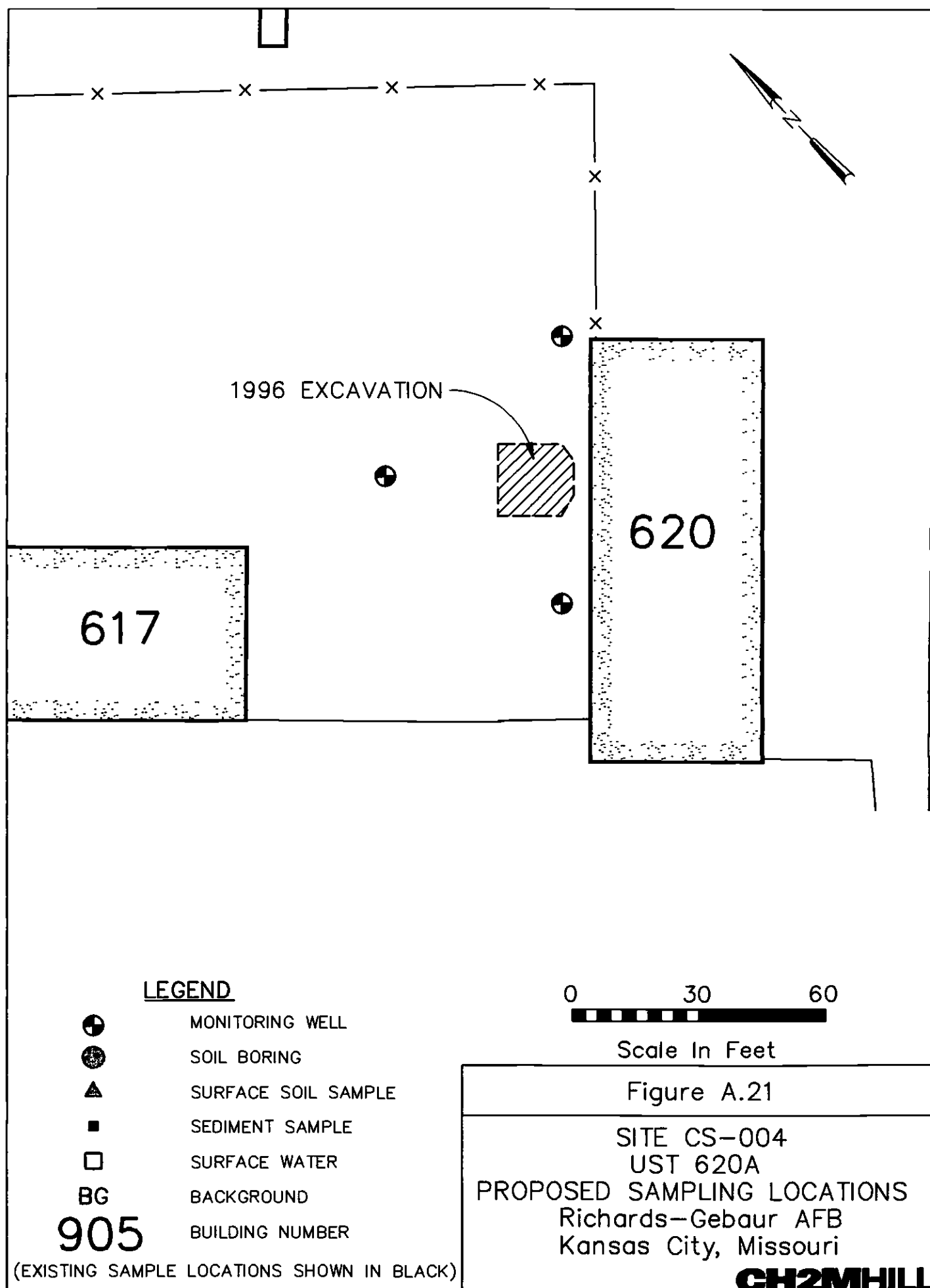
**CH2MHILL**

AFTER DAMES AND MOORE, 1996

PLOT TIME: 15:36:39

PLOT DATE: 25-OCT-1999

FILENAME: 3673c07d.dlv



## 8.0 SSP – FT 002

### North Burn Pit

---

#### 8.1 Introduction

This site sampling plan describes the proposed sampling approach at FT 002. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

##### 8.1.1 Site Description

FT 002, North Burn Pit Area, is located north of the flightline as indicated in **Figure A.22**. The site occupies approximately 100,000 square feet of ground and is situated on a topographic high. It is not located in a flood plain. The pit itself is paved, and is surrounded by grass and bushes. The area is bounded by a chain-link fence.

##### 8.1.2 Summary of Previous Investigations

The site was first constructed in 1965 for fire department training and storage of combustible materials (Jacobs, 1995). From 1965 to 1969, waste oils, solvents, and fuels were routinely stored in 55-gallon drums and burned in the unlined pit. The facility was upgraded in 1969 with a 50-foot radius concrete slab lining, a six inch retaining curb, an OWS for receiving pit runoff drainage, and a 5,000-gallon aboveground storage tank (AST) for storing waste materials prior to burning (CH2M HILL, 1983). After the pit was upgraded, JP-4 fuel was the only flammable liquid used in training exercises. The AST was removed in 1988 when training exercises were discontinued (O'Brien & Gere, 1991). The buried product and dispensing lines were cleaned, flushed with potable water, and vented in 1996 (Dames & Moore, 1996a).

The site was identified as an IRP site as a result of a Phase I Records Search in 1983 (CH2M HILL, 1983). Seven monitoring wells have been installed at the site. A small fuel spill and one incident of OWS failure have been reported and noted (Ecology & Environment, 1988).

During 1986, a field investigation was performed at the site as part of a Phase II Confirmation/Quantification Study. The investigation included installation and sampling of three monitoring wells. Fifteen soil samples and one surface water sample were also collected. A soil gas survey was also conducted to determine the optimal placement for soil borings, monitoring wells, and surface soil and surface water sampling locations (Ecology and Environment, 1988).

In 1989, four additional monitoring wells were installed and additional surface soil and groundwater samples were collected as part of a Remedial Investigation (O'Brien and Gere, 1991). In 1991, two monitoring wells were abandoned and another round of groundwater samples was collected from the remaining wells (Burns and McDonnell, 1992). After the fire training area was closed, the product dispensing lines were cleaned out and flushed (Dames & Moore, 1996a). In 1996, one of the wells abandoned in 1991 was re-installed (Versar, 1996d).

Sampling locations examined during previous locations are displayed in **Figure A.23**.

### 8.1.3 Current Site Status

Currently, the North Burn Pit is deactivated and fenced. Public access is prohibited. The 5,000-gallon AST has been removed. The product and dispensing lines have been cleaned and remain in place. However, additional site characterization is required to assess the potential for soil contamination beneath the pit that occurred before the concrete pit was installed.

## 8.2 Chemicals of Concern

The COC are those associated with waste oils, solvents and fuels. Several episodes of soil, groundwater, and surface water sampling have been conducted to evaluate the potential occurrence and distribution of hydrocarbons and metals at the site.

### 8.2.1 Soil

In 1986, nine subsurface and six surface soil samples were collected and analyzed for TPH and VOCs (Ecology and Environment, 1988). No TPH constituents were detected above the MDNR UST action level of 50 ppm. No VOCs were detected in any of the soil samples.

Additional surface soil samples were collected in 1991 (O'Brien & Gere, 1991). The samples were analyzed for VOCs, SVOCs, and metals. No VOCs or SVOCs were detected. Lead was detected in one sample at a concentration of 440 ppm. The concentration exceeded the Any-use Soil Level of 240 ppm that was applicable as guidance in 1991; however, it is below the current CALM STARC level for commercial land use of 660 ppm.

### 8.2.2 Groundwater

Groundwater samples have been collected from the well locations shown in **Figure A.23**. As part of the 1986 investigation, three groundwater samples were collected and analyzed for VOCs. No VOCs were detected at concentrations above their respective MCLs. Reportedly, there was only enough sample volume for VOC analysis because of insufficient groundwater recharge in two of three wells (Ecology & Environment, 1988).

Four additional groundwater samples were collected from newly installed monitoring wells in 1989. The samples were analyzed for VOCs, SVOCs, and metals (O'Brien & Gere, 1991). The three previously installed wells were dry and were not sampled. No VOCs or SVOCs were detected above action levels. Three out of four unfiltered samples analyzed for metals contained concentrations of chromium (0.18 ppm, 0.29 ppm, and 0.11 ppm) and lead (0.12 ppm, 0.20 ppm, and 0.11 ppm) above their applicable maximum contaminant levels (MCLs) of 0.1 ppm and 0.05 ppm, respectively. However, the clay soils in Missouri have naturally high background concentrations of these metals. Because the groundwater samples were unfiltered, concentrations may reflect this natural occurrence. Furthermore, the trace concentrations of chromium and lead are not consistent with the broad use of petroleum hydrocarbon products at the site for firefighting exercises.

In 1991, four groundwater samples were again collected from the wells installed in 1989. The samples were analyzed for VOCs, filtered metals, common anions, common cations, alkalinity, and TDS (Burns & McDonnell, 1992). The three previous monitoring wells installed in 1986 were again found to be dry. No VOCs, metals, anions, or cations were detected above applicable action levels. Alkalinity ranged from 218 ppm to 540 ppm. TDS values were below the State drinking water standard of 500 ppm.

Two monitoring wells at the site were abandoned in 1992. One of the wells was subsequently reinstalled in 1996 (Versar, 1996a) and sampled. The groundwater sample was analyzed for TPH, VOCs, SVOCs, metals, pesticides, and PCBs. None of the analytes were detected above their respective action levels.

### 8.2.3 Surface Water

One surface water sample was collected from an area of standing water inside the fenceline during the 1986 site investigation (Ecology & Environment, 1988). The sample was analyzed for TPH constituents and VOCs. None of the compounds were detected.

## 8.3 Objectives and Scope

The objectives of the site investigation at FT 002 are as follows:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater

To meet these objectives, the following field activities will be performed at FT 002:

- advance three soil borings, retaining two samples from each for laboratory analyses
- if soil contamination is evident based on field screening and observations, convert one of the soil borings into a monitoring well
- measure groundwater elevations in six existing monitoring wells and the new monitoring well, if it is installed
- collect groundwater samples from six monitoring wells and the new monitoring well, if it is installed
- collect near-surface soil samples from seven locations along the product and dispensing lines
- analyze soil and groundwater samples for VOCs, SVOCs, TPH, metals, PCBs, dioxins, and furans

### 8.3.1 Field Methodologies

The field and analytical methodologies to be used at FT 002 are summarized below.

#### 8.3.1.1 Monitoring Well Installation

Should field screening and observations indicate soil contamination, one of the soil borings completed in the burn pit will be converted into a monitoring well. If constructed, the monitoring well will be installed and developed according to the procedures described in the FSP.

#### 8.3.1.2 Groundwater Sampling

Groundwater samples will be collected from six existing monitoring wells and one new monitoring well, if it is installed. Existing monitoring well locations are shown in **Figure A.24**. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs, SVOCs, TPH, metals, PCBs, dioxins, and furans.

### 8.3.1.3 Soil Sampling

Three soil borings will be drilled through the concrete pit to the top of bedrock. Locations of soil borings are shown in **Figure A.24**. Each boring will be continuously sampled from the surface to completion. A total of six soil samples, two from each boring, will be retained for laboratory analysis. At each boring, one sample will be selected based upon the result of field screening, described in the FSP, and at the discretion of the field geologist. The second sample shall be collected from a depth interval immediately above the water table. The selected samples will be analyzed for VOCs, SVOCs, TPH, metals, PCBs, dioxins, and furans. As described above, if soil contamination is evident based on field screening and observations, then one of the soil borings will be converted into a monitoring well.

Seven additional soil samples will be collected from soil borings located at 100-foot intervals along the length of product and dispensing lines, in accordance with MDNR UST closure guidelines. The samples will be collected using split-spoons at depths corresponding to 6-12 inches below the invert of the fuel line and analyzed for the same parameters as above.

### 8.3.1.4 Surface Water Sampling

No surface water samples will be collected at FT 002 during the Basewide RI/FS.

### 8.3.1.5 Sediment Sampling

No sediment samples will be collected at FT 002 during the Basewide RI/FS.

## 8.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at FT 002 to provide quality control. The following QA/QC samples will be collected at FT 002

- one duplicate water sample
- two duplicate soil samples

In addition to field duplicates, other QA/QC samples may be collected, including ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

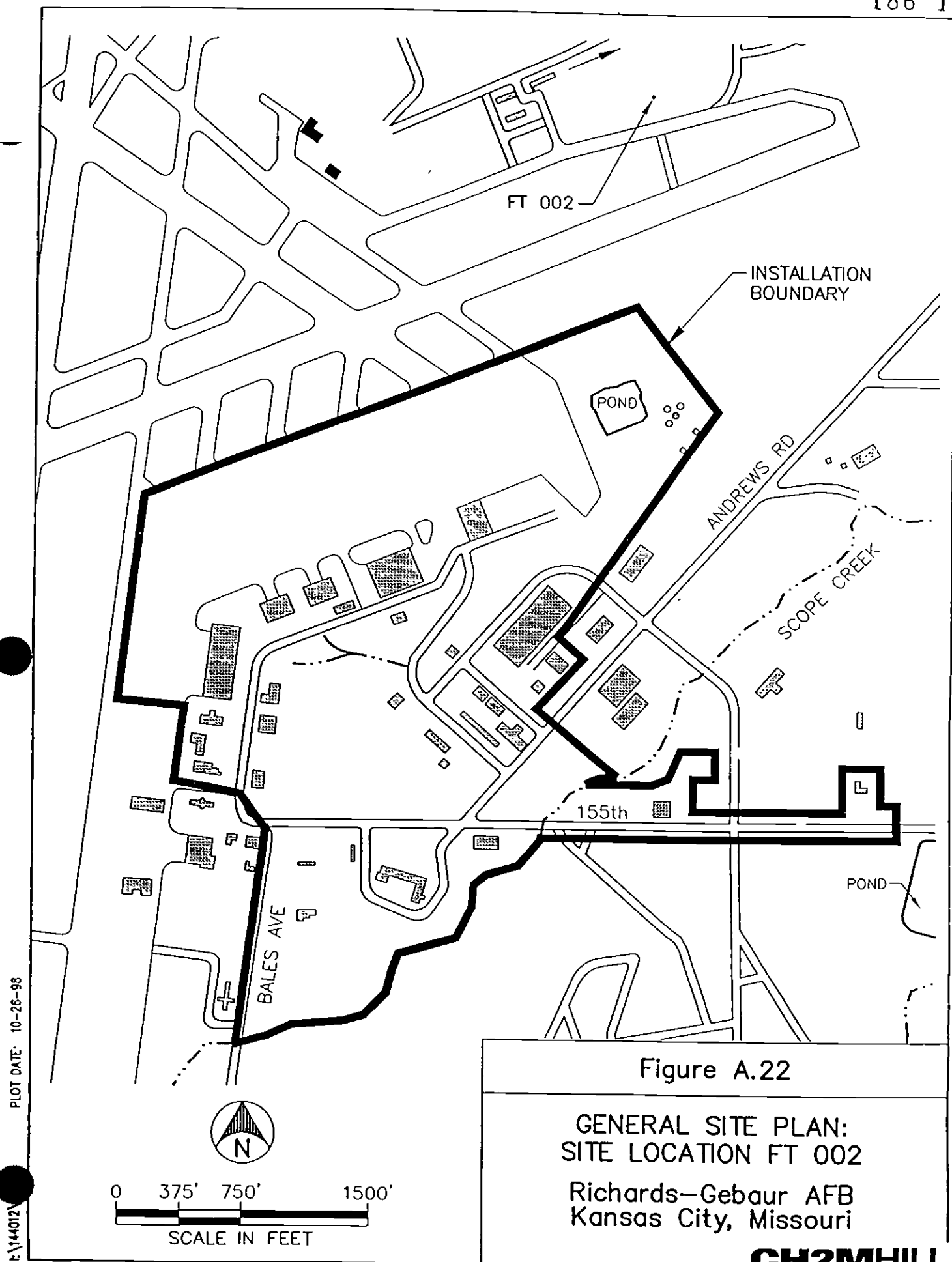


### 8.3.3 Laboratory Analyses

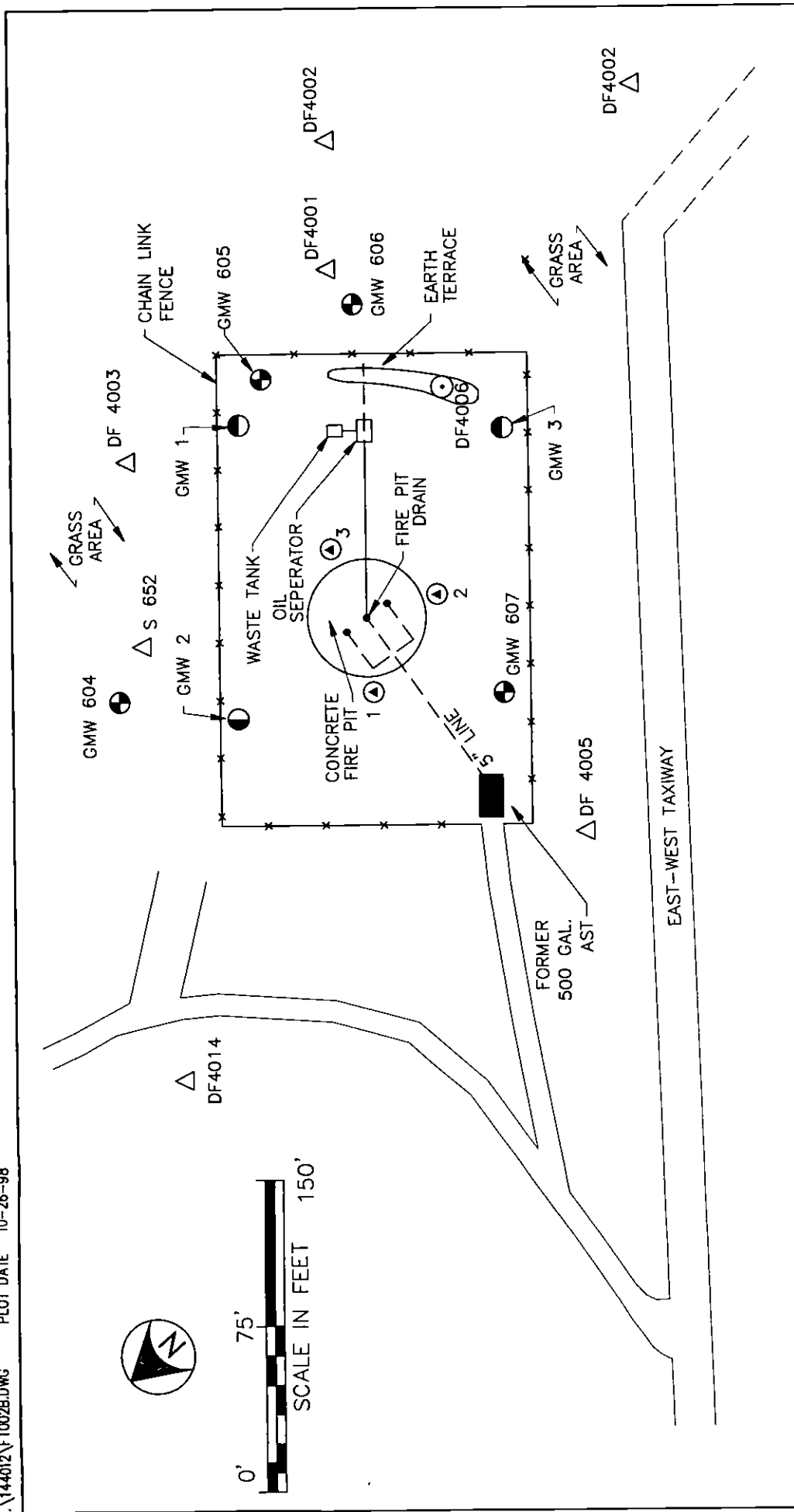
Table A-8 lists the analytical parameters for soil, groundwater, and associated QC samples.

**Table A-8 Summary of Sample Analyses - FT 002**

Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater <sup>1</sup>	7 <sup>2</sup>	√	√	√	√	√
Soil <sup>1</sup>	13	√	√	√	√	√
<b>QA/QC Samples<sup>3</sup></b>						
Field Duplicates <sup>1,4</sup>	3	√	√	√	√	√
<b>Notes</b> 1. Field and QA/QC samples will be analyzed for dioxins and furans. 2. Groundwater samples will be collected from six existing monitoring wells and one new monitoring well, if it is installed 3. In addition to field duplicates, other QA/QC samples may include: ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP. 4. At least one field duplicate shall be collected for each sample medium. 5. Samples will also be analyzed for dioxins and furans.						



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# LEGEND

- GROUND WATER MONITORING WELL (INSTALLED 8/89)
- IAP PHASE II STAGE 2 WATER MONITORING WELL
- △ SURFACE SOIL SAMPLES
- SURFACE WATER SAMPLE
- ⊙ SOIL BORING
- PIPING RUN

Figure A.23

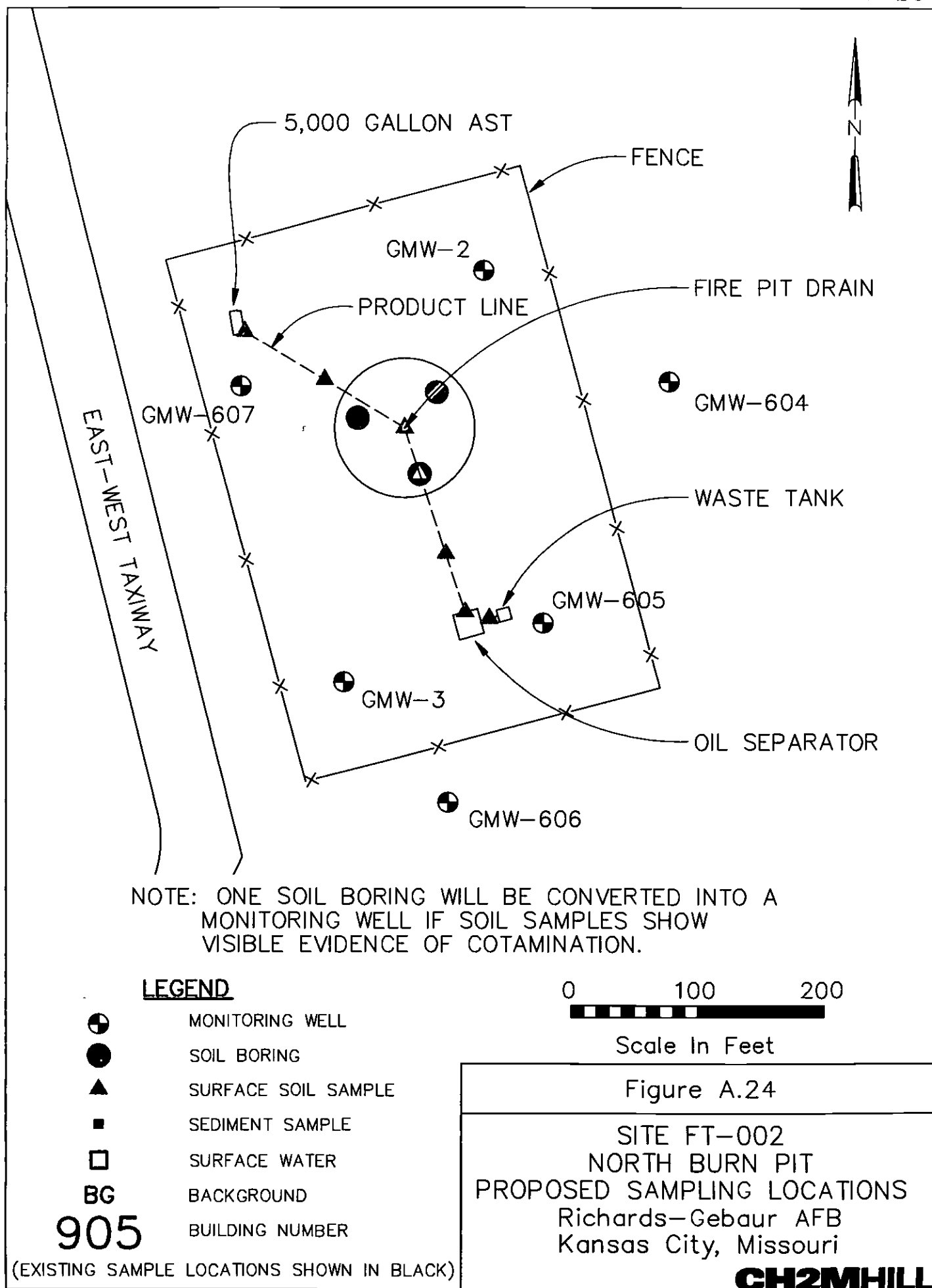
**NORTH BURN PIT AREA WELLS  
AND SAMPLING LOCATIONS**  
SITE LOCATION FT 002  
Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

PLOT TIME: 14:25:31

PLOT DATE: 25-OCT-1999

FILENAME: 3673c08d.dlv



## 9.0 SSP – SS 003

### Oil Saturated Area

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#### 9.1 Introduction

This site sampling plan describes the proposed sampling approach at SS 003. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

##### 9.1.1 Site Description

SS 003, the Oil Saturated Area, is located south of 155<sup>th</sup> Street, southwest of Building 704 (**Figure A.25**). It was used to store waste oil products generated from the mid-1950s to the late 1980s by routine maintenance of the Motor Pool vehicles (USAF, 1994a). The site is part of the former waste oil storage area and originally covered approximately 1,600 square feet (Versar, 1996d). The site is paved and flat. A grassy swale runs parallel to the west and south fencelines. The site is on a small hill and is not located in or near a floodplain.

##### 9.1.2 Summary of Previous Investigations

SS 003 was initially identified during a Phase I Records Search of the Air Force Base (CH2M HILL, 1983). The site was recognized at that time as being oil stained. The site was further investigated in 1986 and soil and surface water samples were collected and analyzed (Ecology and Environment, 1988). Two additional field samples were collected in 1989 as part of a Remedial Investigation (O'Brien and Gere, 1991). In 1991, approximately 42 cubic yards of contaminated soil was removed from SS 003 (Burns and McDonnell, 1992). Subsequently, in 1996, a groundwater assessment was conducted at the site (Versar, 1996d).

##### 9.1.3 Current Site Status

SS 003 has not been used since the late 1980s. The affected soil has been removed and the excavated area has been backfilled with clean fill. However, further site characterization is recommended to better evaluate groundwater flow direction and hydraulic gradient.

#### 9.2 Chemicals of Concern

Potential COC at the Oil Saturated Area include BTEX compounds, TPH constituents, PAH compounds, and metals. Soil, groundwater and surface water sampling have been performed to evaluate the extent and distribution of these chemicals at the site.

##### 9.2.1 Soils

Six surface soil samples and three subsurface soil samples were collected from SS 003 (Ecology & Environment, 1988). Three of the surface soil samples were collected from the nearby drainage swales. The samples were analyzed for TPH, VOCs, and metals. The three surface samples had concentrations of hydrocarbon constituents above the MDNR action level of 50 ppm, with a maximum TPH value of 3,800 ppm. Lead was also detected in one surface

soil sample at a concentration of 343 ppm, exceeding the applicable MDNR action level of 240 ppm. No VOCs were detected in any of the soil samples.

Three surface soil samples were collected adjacent to the drainage swale in the second site investigation in 1989 (O'Brien & Gere, 1991). The samples were analyzed for VOCs, SVOCs, and metals. None of the above chemicals were found to exceed their respective MDNR action levels.

In November 1991, 27 cubic yards of soil was excavated from the oil saturated area SS 003 (**Figure A.26**). The soil was removed in layers to a depth of two feet and was continuously screened for VOCs using a photoionization detector.

Following excavation, two soil samples were collected from the excavation base to confirm that the affected soils had been successfully removed. The samples were analyzed for TPH constituents and lead. One sample exceeded the MDNR action level for TPH of 50 ppm, indicating that further excavation was required at this location.

In February 1992, an additional 15 cubic yards of soil was excavated from SS 003. Two post-excavation soil samples were taken from the undisturbed subgrade. The laboratory analytical results showed that residual soil concentrations of TPH constituents and lead were below the respective MDNR action levels of 50 ppm for TPH and 240 ppm for lead, with the exception of one sample at a concentration of 53 ppm TPH (Burns & McDonnell, 1992b).

### 9.2.2 Groundwater

A preliminary groundwater assessment was conducted at SS 003 in 1996 to determine if the petroleum constituents found at SS 003 had affected groundwater quality (Versar, 1996d). Three groundwater monitoring wells were installed to depths of 20 feet, 32 feet, and 34 feet below ground surface. One well was located in the center of the excavation and two wells were placed in the drainage swale south of the site (**Figure A.26**).

A piezometer was installed also (depth 18 feet), but was dry after an elapsed time of 48 hours and was abandoned in accordance with applicable MDNR procedures.

Groundwater samples were collected from each well and analyzed for TPH constituents, VOCs, and metals. No TPH constituents were detected and none of the analyzed compounds were detected at concentrations that exceeded MCLs (Versar, 1996d).

### 9.2.3 Surface Water and Sediments

One surface water sample was collected during the 1986 site investigation and analyzed for TPH, VOCs, and metals (Ecology & Environment, 1988). The sample was collected from the stormwater drainage swale. No chemicals were detected above applicable action levels.

No sediment samples were collected because the drainage swales are covered with grass

## 9.3 Objectives and Scope

The objectives of the site investigation at SS 003 are as follows:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater

To meet these objectives, the following field activities will be performed at SS 003:

- install one monitoring well to supplement the three existing wells
- measure groundwater elevations at the one new well and the three existing wells
- collect groundwater samples from four monitoring wells
- collect three soil samples from the new monitoring well boring
- analyze soil and groundwater samples for VOCs, SVOCs, TPH, and metals

### 9.3.1 Field Methodologies

The field and analytical methodologies to be used at SS 003 are summarized below.

#### 9.3.1.1 Monitoring Well Installation

One new monitoring well will be installed at SS 003. The well will be drilled between 6 and 18 inches into the upper bedrock unit. The proposed well location is shown in **Figure A.27**. The monitoring well location may be modified during the Basewide Remedial Investigation, depending on the location of underground utilities. The monitoring well will be installed and developed according to the procedures described in the FSP.

#### 9.3.1.2 Groundwater Sampling

Four groundwater samples will be collected from the onsite wells. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs, SVOCs, TPH, and metals.

#### 9.3.1.3 Soil Sampling

Soil samples will be collected during the drilling of the monitoring well boring. The boring will be continuously sampled from the surface to completion. Three soil samples will be retained for laboratory analyses. The samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. The select samples will be analyzed for VOCs, SVOCs, TPH, and metals.

#### 9.3.1.4 Surface Water Sampling

No surface water samples will be collected at SS 003 during the Basewide RI/FS.

#### 9.3.1.5 Sediment Sampling

No sediment samples will be collected at SS 003 during the Basewide RI/FS.

### 9.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at SS 003 to provide quality control. The following QA/QC samples will be collected during the site investigation at SS 003:

- one duplicate groundwater sample
- one duplicate soil sample

In addition to field duplicates, other QA/QC samples may be collected during the investigation at SS 003. These samples include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

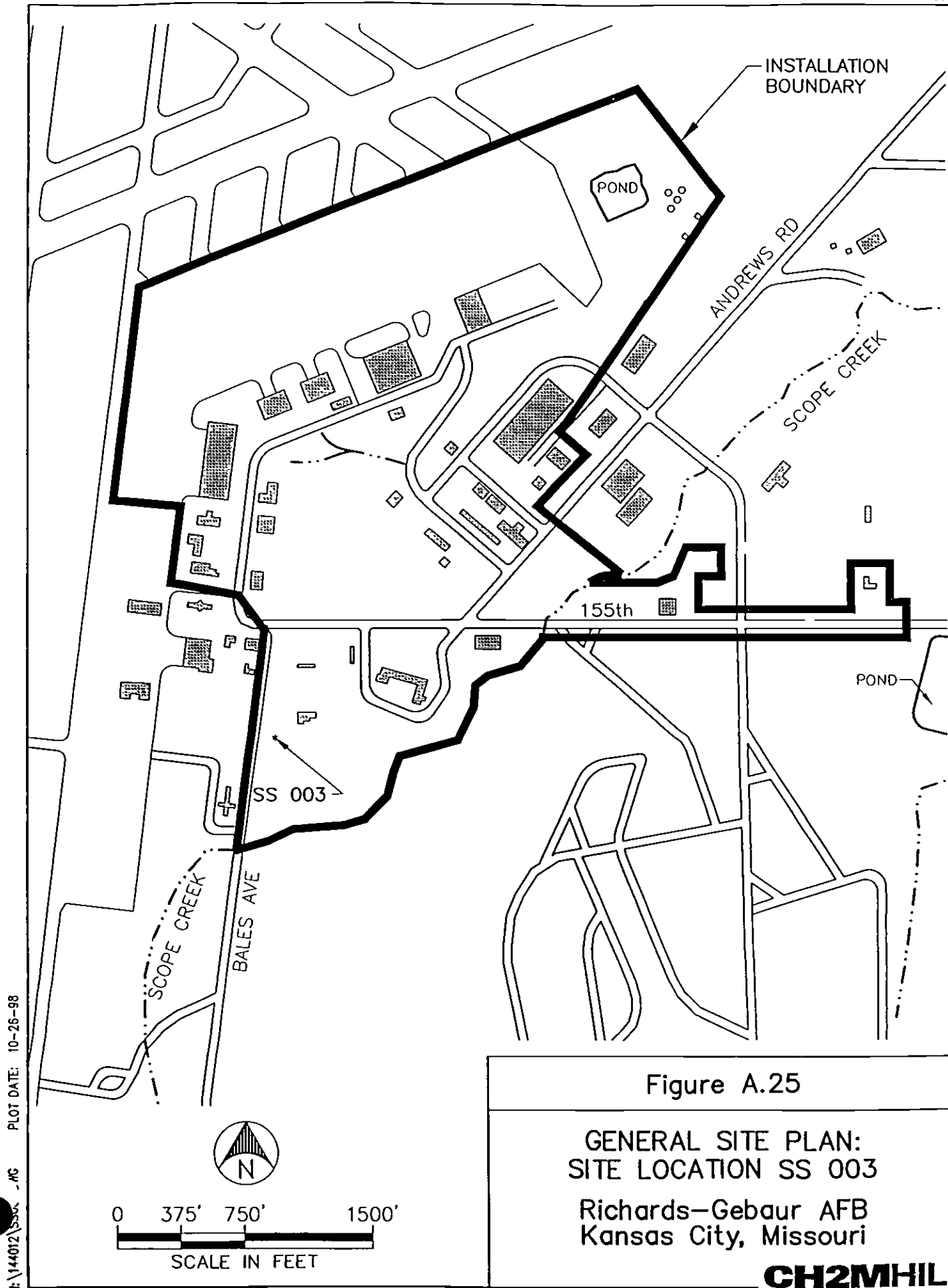
### 9.3.3 Laboratory Analyses

Table A-9 lists the analytical parameters for soil, groundwater, and associated QC samples.

**Table A-9 Summary of Sample Analyses - SS 003**

Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater	4	√	√	√	√	
Soil	3	√	√	√	√	
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicate <sup>2</sup>	2	√	√	√	√	
<b>Notes</b>  1. In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP.  2. At least one field duplicate shall be collected for each sample medium.						





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AFTER VERSAR INC., 1996

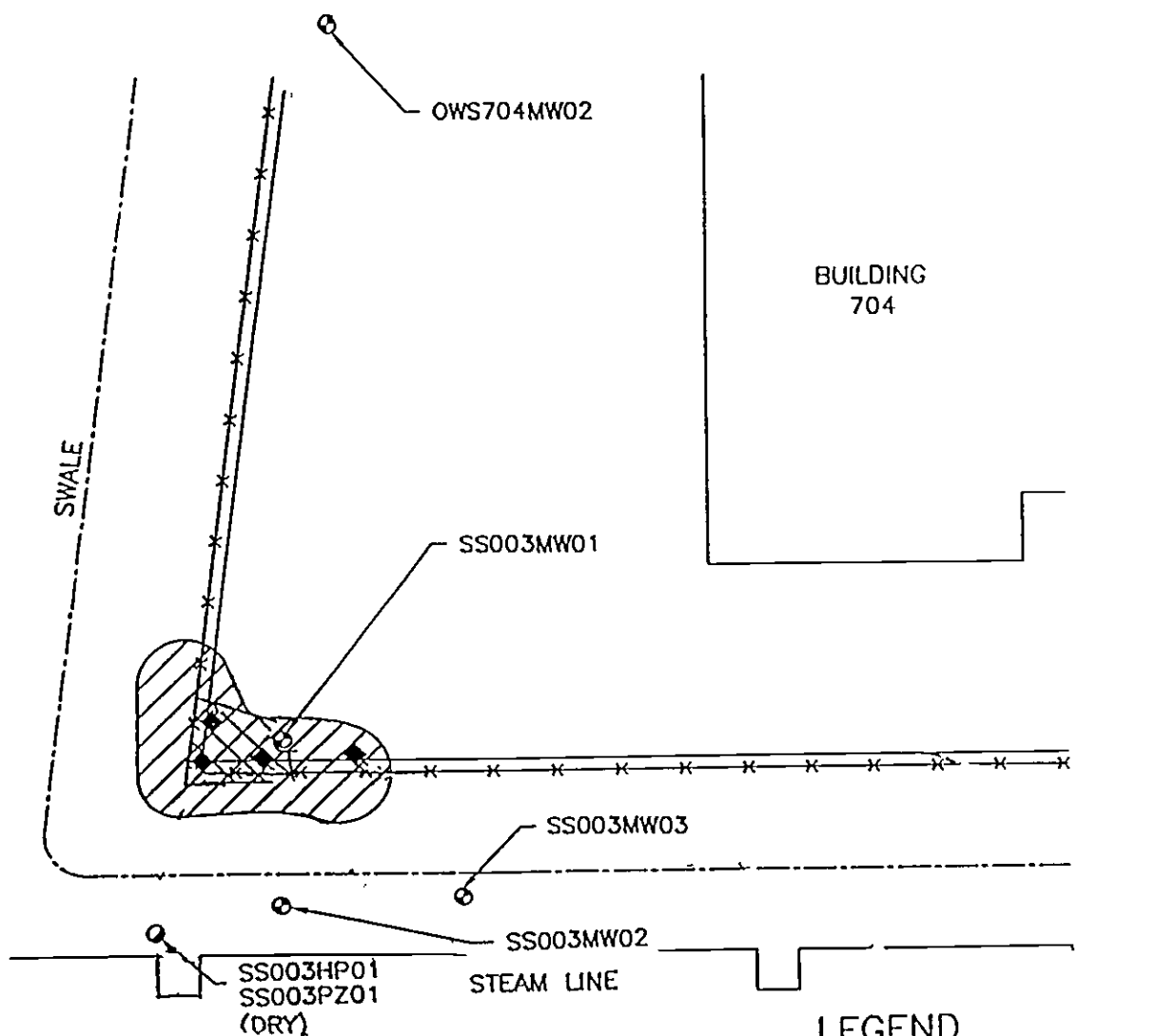


Figure A.26

MONITORING WELL AND  
SOIL BORING LOCATIONS  
SITE LOCATION SS 003  
Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

PLOT DATE: 10-26-98

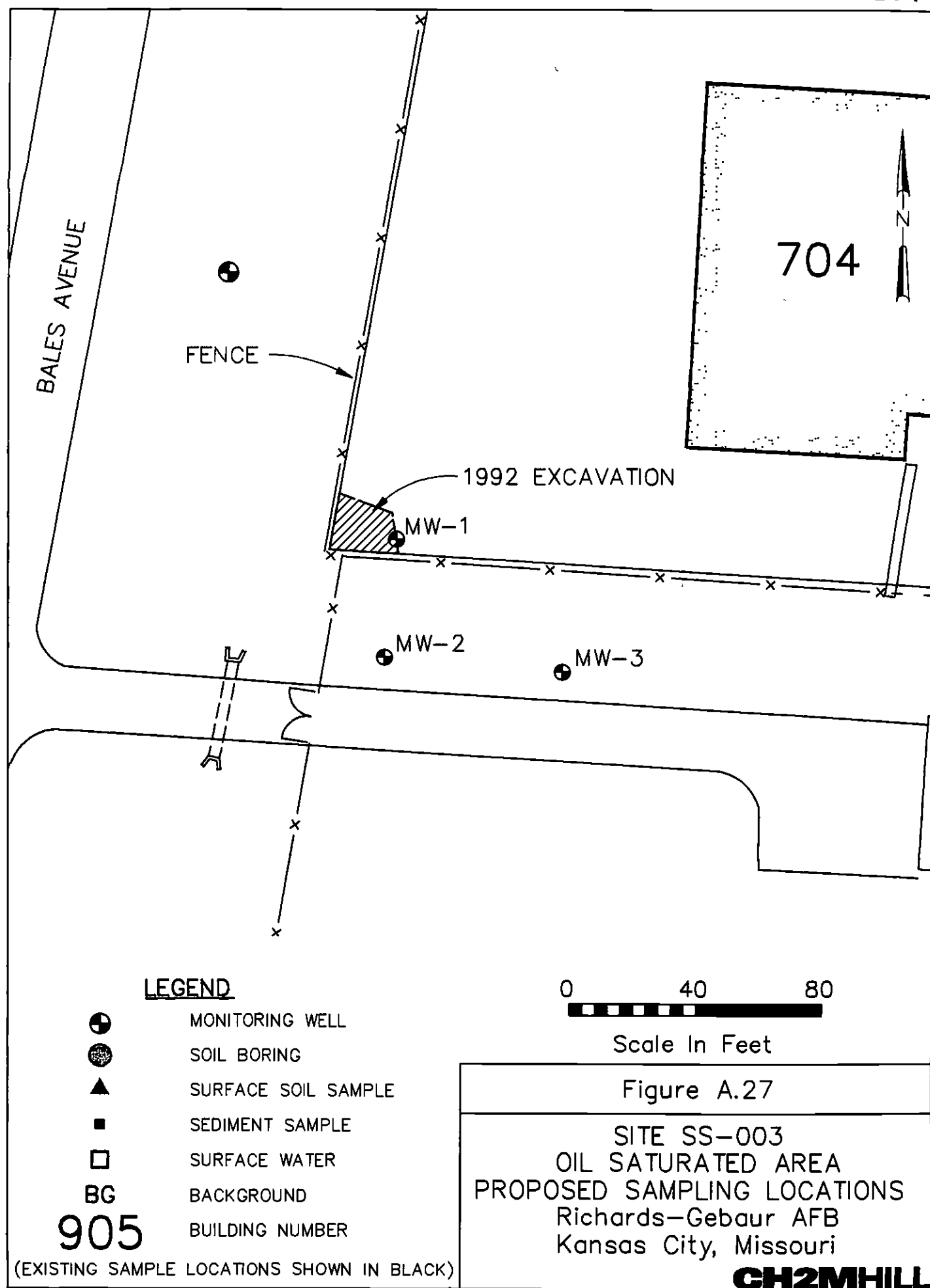
WG

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PLOT TIME:14:29:58

PLOT DATE:25-OCT-1999

FILENAME: 3673c09d.dlv



## 10.0 SSP – SS 004

# Hazardous Waste Drum Storage Area

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### 10.1 Introduction

This site sampling plan describes the proposed sampling approach at SS 004. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

#### 10.1.1 Site Description

SS 004 is located at the southwest corner of Building 923, north of the intersection of Andrews Road and 155<sup>th</sup> Street. The site location is shown on **Figure A.28**. The area was used for storage of hazardous and non-hazardous drummed wastes, primarily waste engine oil, pending proper disposal (USAF, 1994a). The site is approximately 900 square feet in area. It is partially paved.

#### 10.1.2 Summary of Previous Investigations

SS 004 was used as a hazardous waste storage area from the 1960s to 1985. No hazardous materials have been stored in the area since 1985 (USAF, 1994a). It is likely that small spills or leaks have occurred that contributed to contamination of surface soils during its operation. The volume of contaminated soil was estimated by the Air Force to be approximately 23 cubic yards (Burns & McDonnell, 1992e).

The site was initially identified during a Phase II environmental study in 1988 (USAF, 1993). Eight soil samples and one surface water sample were collected (Ecology and Environment, 1988). Additional field samples were collected in 1989 as part of a Remedial Investigation (O'Brien and Gere, 1991).

In 1991, approximately 15 cubic yards of contaminated soil was removed from SS 004 (Burns and McDonnell, 1992e). In 1996, a preliminary groundwater assessment was conducted at the site (Versar, 1996a).

Sampling locations during previous site investigations are displayed in **Figure A.29**.

#### 10.1.3 Current Site Status

The site is inactive and fenced. The excavation has been backfilled with clean soil.

### 10.2 Chemicals of Concern

Potential COC at the Hazardous Waste Drum Storage Area are VOCs, SVOCs, TPH, and metals. Soil and groundwater sampling was performed to evaluate the extent and distribution of these chemicals at the site.

### 10.2.1 Soils

Soil samples collected in 1988 from SS 004 were analyzed for TPH, VOCs, and metals (Ecology & Environment, 1988). TPH constituents were detected above the MDNR action level of 50 ppm in two of eight soil samples, with concentrations of 140 ppm and 1,900 ppm. The higher value was found in the surface sample collected directly beside the fence where the drums had been previously stored. However, a soil sample collected from a nearby drainage depression indicated a TPH value of 2.9 ppm, well below the MDNR action level. VOCs and metals were not detected in any of the soil samples. Four more surface soil samples were collected from the drainage depression in 1989 and analyzed for VOCs, SVOCs, and metals (O'Brien & Gere, 1991). None of the samples contained COC at concentrations above their applicable MDNR action levels.

Fifteen cubic yards of soil were excavated from the hazardous waste storage area in 1991 (Burns & McDonnell, 1992e). Excavation was terminated when field screening using a photo-ionization detector consistently failed to indicate the presence of VOCs contamination. Two post-excavation soil samples were collected to verify that the contaminated soils had been removed from the site. Laboratory analyses for TPH constituents and metals confirmed that residual chemical concentrations were below the relevant State action levels for TPH and metals.

### 10.2.2 Groundwater

Three groundwater-monitoring wells were installed to depths of between 18 feet and 25 feet below ground surface (Versar, 1996a). A groundwater sample was collected from each well and analyzed for TPH constituents, VOCs, and metals. No TPH constituents were detected. Furthermore, no VOCs or metals were detected at concentrations that exceeded MCLs.

## 10.3 Objectives and Scope

The objectives of the site investigation at SS 004 are as follows:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater

To meet these objectives, the following field activities will be performed at SS 004:

- install one monitoring well
- measure groundwater elevations at the one new well and three existing wells
- collect groundwater samples from four monitoring wells
- collect three soil samples from the well boring
- analyze soil and groundwater samples for VOCs, SVOCs, TPH and metals

### 10.3.1 Field Methodologies

The field and analytical methodologies to be used at SS 004 are summarized below.

#### 10.3.1.1 Monitoring Well Installation

One new monitoring well will be installed at SS 004. The well will be drilled between 6 and 18 inches into the upper bedrock unit. The proposed well location is shown in **Figure A.30**. The monitoring well location may be modified during the Basewide Remedial Investigation, depending on the location of underground utilities. The monitoring well will be installed and developed according to the procedures described in the FSP.

#### 10.3.1.2 Groundwater Sampling

Four groundwater samples will be collected from the one new well and the three existing wells. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs, SVOCs, TPH, and metals.

#### 10.3.1.3 Soil Sampling

Soil samples will be collected during the drilling of the monitoring well boring. The new monitoring well boring will be continuously sampled from the surface to completion. Three soil samples will be retained for laboratory analyses. The samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. The select samples will be analyzed for VOCs, SVOCs, TPH, and metals.

#### 10.3.1.4 Surface Water Sampling

No surface water samples will be collected at SS 004 during the Basewide RI/FS.

#### 10.3.1.5 Sediment Sampling

No sediment samples will be collected at SS 004 during the Basewide RI/FS.

### 10.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at SS 004 to provide quality control. The following QA/QC samples will be collected during the site investigation at SS 004:

- one duplicate groundwater sample
- one duplicate soil sample

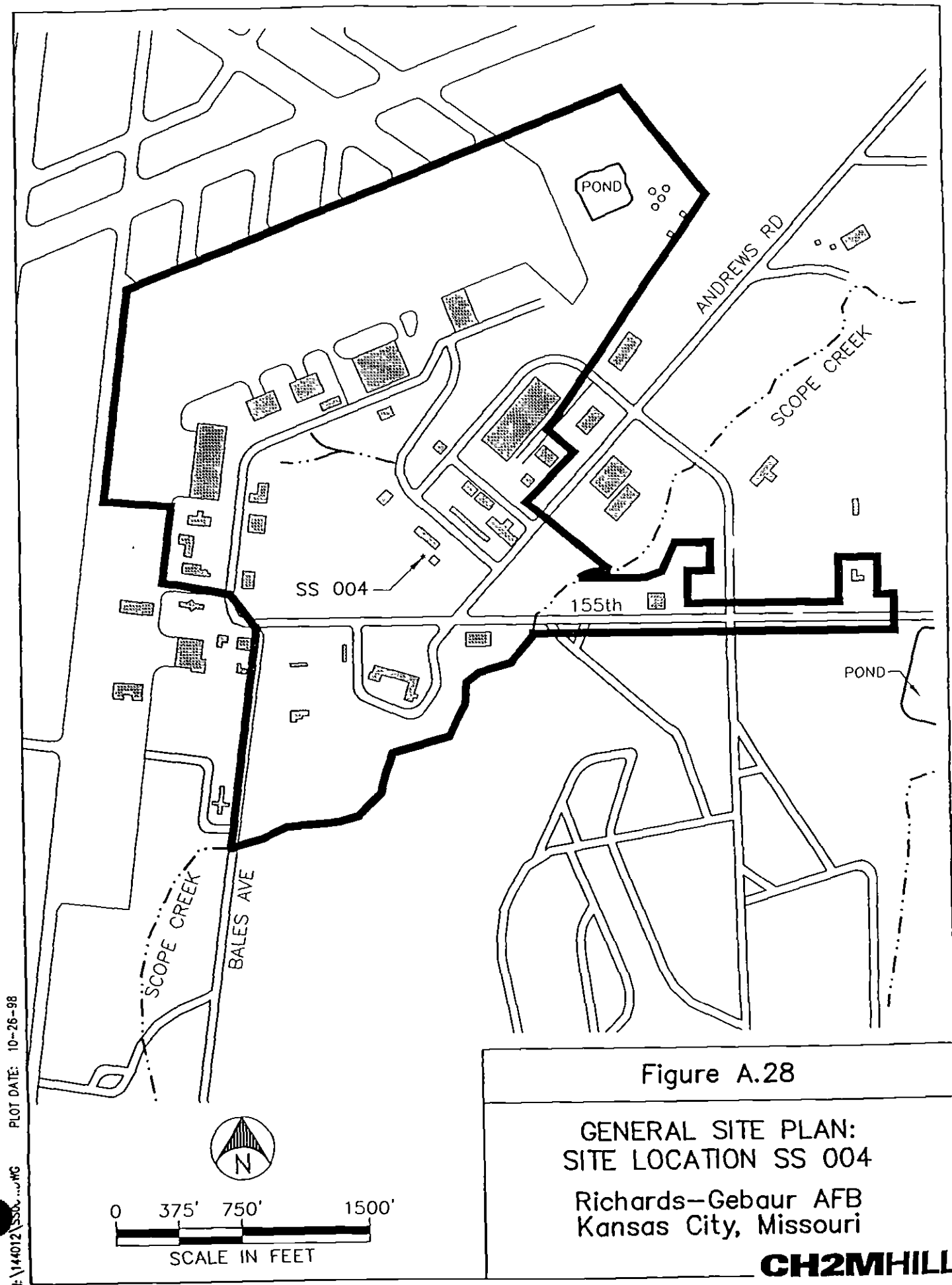
In addition to field duplicates, other QA/QC samples may be collected during the investigation at SS 004. These samples include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

### 10.3.3 Laboratory Analyses

Table A-10 lists the analytical parameters for soil, groundwater, and associated QC samples.

Table A-10 Summary of Sample Analyses - SS 004

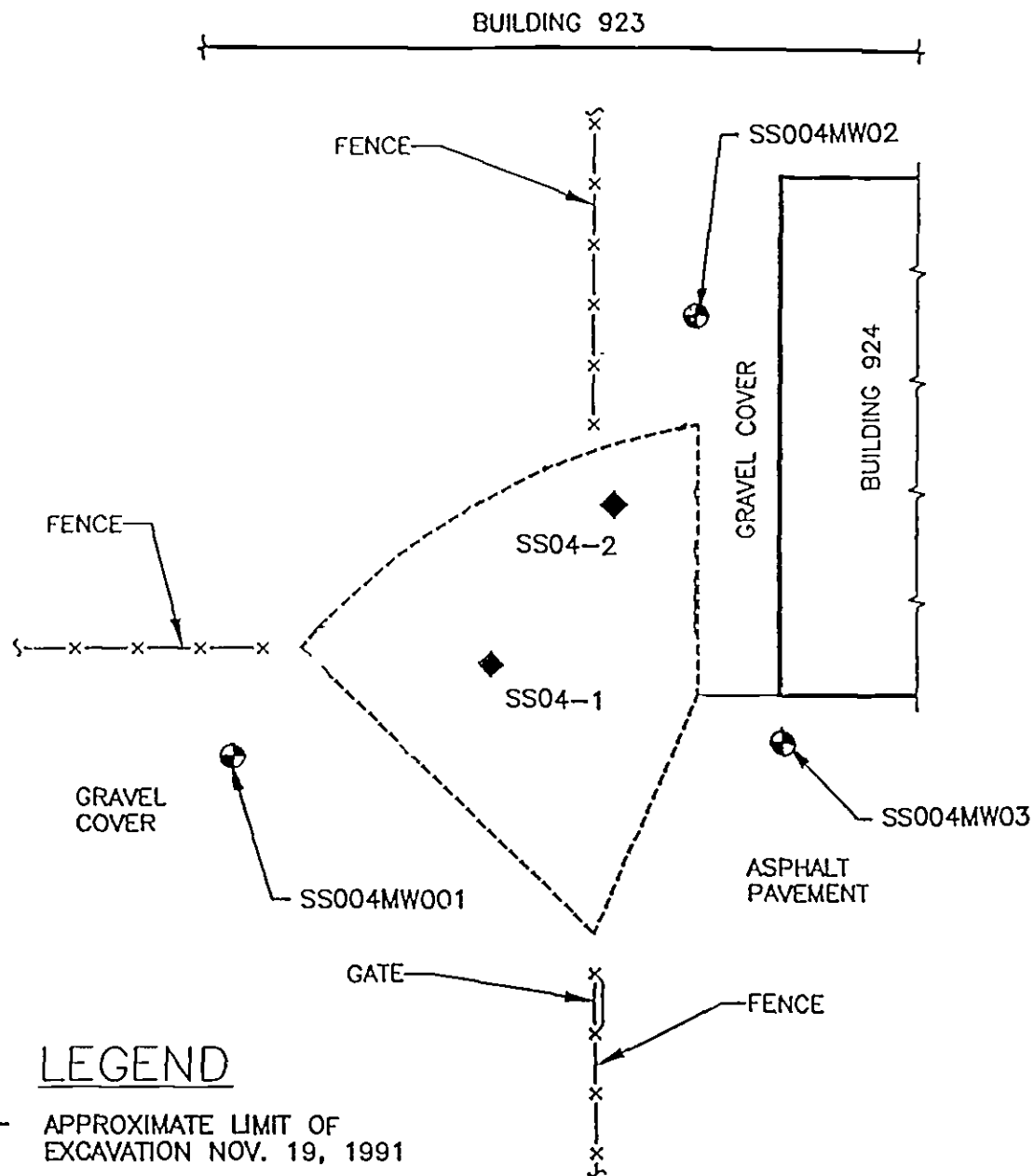
Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater	4	√	√	√	√	
Soil	3	√	√	√	√	
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicate <sup>2</sup>	2	√	√	√	√	
<b>Notes</b>  1 In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP.  2 At least one field duplicate shall be collected for each sample medium.						



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AFTER VERSAR INC., 1996





### LEGEND

- APPROXIMATE LIMIT OF EXCAVATION NOV. 19, 1991
- ◆ SOIL SAMPLE LOCATION
- MONITORING WELL LOCATION

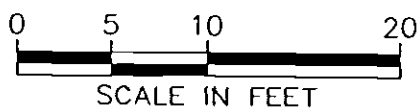


Figure A.29

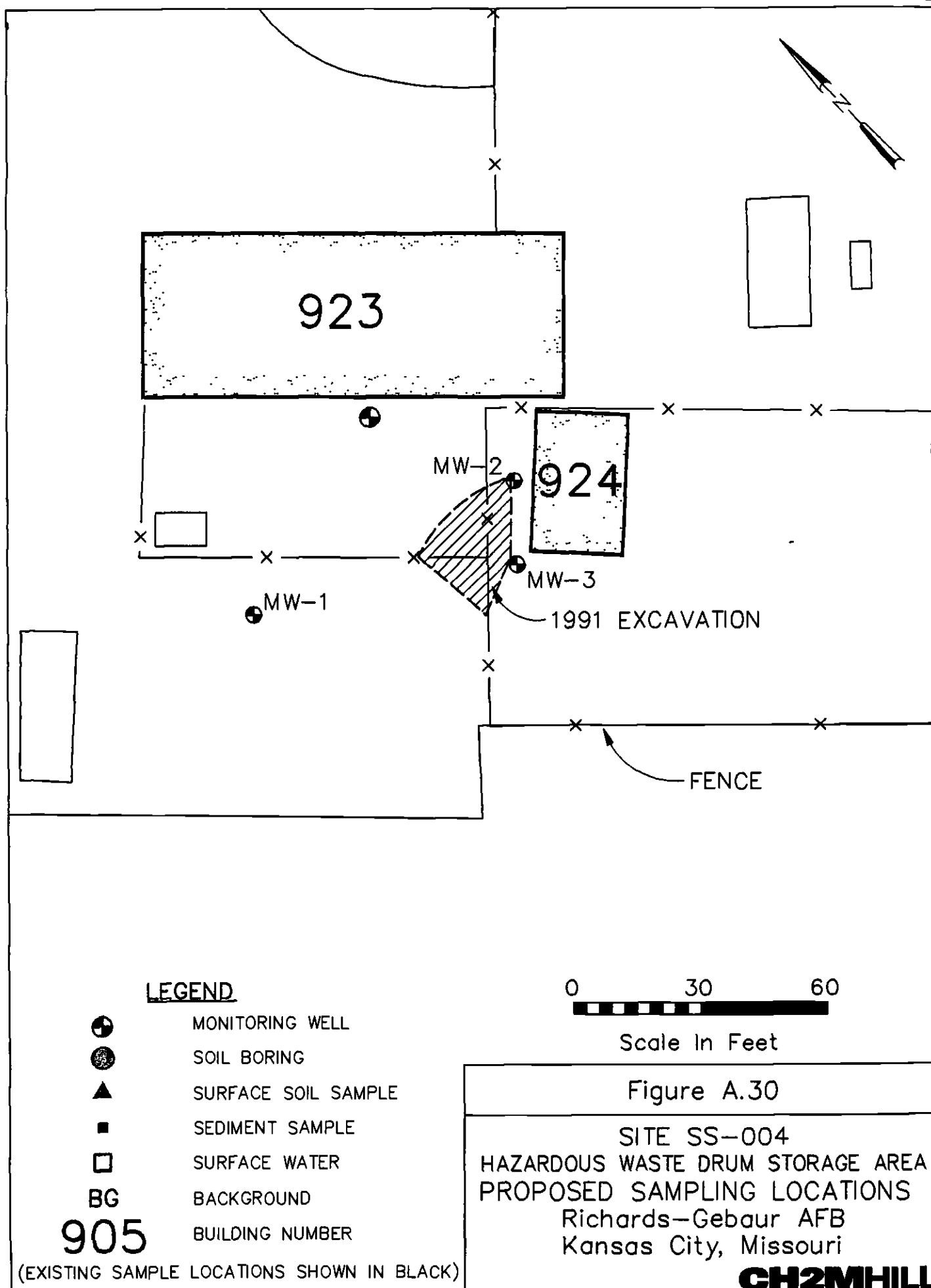
MONITORING WELL AND  
CONFIRMATORY SOIL SAMPLE  
LOCATIONS  
SITE LOCATION SS 004  
Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

PLOT TIME: 14:30:16

PLOT DATE: 25-OCT-1999

FILENAME: 3673c10d.dlv



## 11.0 SSP – SS 006

# Hazardous Material Storage Area

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### 11.1 Introduction

This site sampling plan describes the proposed sampling approach at SS 006. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

#### 11.1.1 Site Description

SS 006, the Hazardous Material Storage Area, is located east of Building 927, east of Hanger Road, north of 155<sup>th</sup> Street. Building 927 was used as an aircraft engine and propeller maintenance shop from 1957 to 1994. An area outside the rear of the building was used to keep bulk supplies of degreasers, solvents, oils and other common workshop materials. The materials were routinely stored in 55-gallon drums or other containers and placed off the ground on racks. The racks were located at the top of a grass embankment above the central drainage area. Site location is shown in **Figure A.31**.

SS 006 is flat lying, although there is a steep downhill embankment immediately east of the storage area. The site's surface drainage is separated from the building drainage by a six-inch high curb (Versar, 1996a). The site is approximately 600 square feet in area and is situated at one of the highest parts of the Base, near the airfield. The site is not located in a floodplain, and no surface water bodies or sediments are present onsite.

#### 11.1.2 Summary of Previous Investigation

The aircraft maintenance workers in Building 927 used SS 006 in the past to store common machine shop materials. Degreasers, solvents, oils, and lubricants were stored on racks outside at the rear of the building. The site was initially identified during a Site Inspection in 1990. According to records, the grass immediately behind the storage racks was discolored and showed signs of stress. In response, two surface soil samples were collected as part of a PA (O'Brien and Gere, 1991). Additional field samples were collected in 1991 during an IRP Site Inspection (Burns and McDonnell, 1993d and 1993e). At this time, the storage rack had been removed and signs of stressed vegetation were now absent. Subsequently, in 1993, approximately 40 cubic yards of contaminated soil was removed from SS 006 (Burns and McDonnell, 1993d). Following the soil removal, a groundwater assessment was conducted at the site (Versar, 1996a).

Sampling locations during previous site investigations are displayed in **Figure A.32**

#### 11.1.3 Current Site Status

Forty yards of contaminated soil has been removed from the Hazardous Material Storage Area. The excavation was backfilled with clean fill material to the surrounding grade elevation. Stressed vegetation is no longer evident.

## 11.2 Chemicals of Concern

The COC at the Hazardous Material Storage Site include TPH, VOCs, and SVOCs, chemicals commonly associated with oils and solvents routinely used during engine and propeller maintenance and repairs. Soil and groundwater sampling has been performed at the site to evaluate the potential extent and distribution of these chemicals.

### 11.2.1 Soils

In 1988, two surface (0-2 feet below grade) soil samples collected from SS 006 were analyzed for VOCs, SVOCs, and metals (O'Brien and Gere, 1991). VOCs were not detected in any samples and no samples showed chemical concentrations above currently applicable MDNR STARCs for commercial land use. However, chrysene was detected in one soil sample at a concentration above the then-applicable ASL of 0.44 ppm.

A follow-up Site Inspection was conducted in 1991 because elevated laboratory detection limits for SVOCs had been reported during the O'Brien & Gere investigation and the results were therefore considered unreliable (Burns & McDonnell, 1993e). Six soil borings were advanced and six soil samples collected, one per boring. The six samples were collected at different depths, from between one foot to six feet below ground surface, and analyzed for SVOCs. One of the six samples, taken at a depth of 2 feet, contained chemicals at concentrations exceeding the previously applicable MDNR ASL of 0.44 ppm for carcinogenic PAH compounds.

Based upon the site data, 40 cubic yards of soil around the hazardous material storage area was excavated to three feet below grade in 1993 (Burns & McDonnell, 1993e). Three post-excavation soil samples were collected from the excavation base and analyzed for SVOCs. Three duplicate soil samples were collected from the same post-excavation sampling locations. The levels of SVOCs in the six soil samples were either below the analytical quantitation limits or else qualified as undetected by the QA/QC review (see Table 3, Burns and McDonnell, 1993).

### 11.2.2 Groundwater

A preliminary groundwater assessment was conducted at SS 006 in 1996 (Versar, 1996a). Three direct-push monitoring wells were installed to the top of bedrock at the site (about four feet below grade) but remained dry after a 48-hour period. One groundwater monitoring well was installed into bedrock in the center of the excavation area to a depth of 16 feet below ground surface. The locations of groundwater monitoring wells are shown in **Figure A.32**.

A groundwater sample was collected and analyzed for metals, VOCs, SVOCs, and TPH. Metal concentrations were below applicable MDNR action levels. Three VOCs (vinyl chloride, cis-1, 2-dichloroethene, and trichloroethene) exceeded the respective State MCLs. One SVOC, bis(2-ethylhexyl)phthalate, was detected at a concentration of 10 ppb, slightly above the State MCL of 6 ppb. No TPH constituents were detected in the samples.

## 11.3 Objectives and Scope

The objectives of the site investigation at SS 006 are as follows:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater
- evaluate potential for natural attenuation at the site

To meet these objectives, the following field activities will be performed at SS 006:

- install three monitoring wells
- measure groundwater elevations at the three new wells and one existing well
- collect groundwater samples from four monitoring wells
- collect one soil sample from each new monitoring well boring
- collect three soil samples from one boring completed within the area excavated in 1996
- analyze soil and groundwater samples for VOCs, SVOCs, TPH, and metals
- analyze groundwater samples for natural attenuation parameters

### 11.3.1 Field Methodologies

The field and analytical methodologies to be used at SS 006 are summarized below.

#### 11.3.1.1 Monitoring Well Installation

Three new monitoring wells will be installed at SS 006. The wells will be drilled between 6 and 18 inches into the upper bedrock unit. The proposed well locations are shown in **Figure A.33**. The monitoring well locations may be modified during the Basewide Remedial Investigation, depending on the location of underground utilities. The monitoring wells will be installed and developed according to the procedures described in the FSP.

#### 11.3.1.2 Groundwater Sampling

Four groundwater samples will be collected from the three new wells and the one existing well. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs, SVOCs, TPH, metals, and natural attenuation parameters.

#### 11.3.1.3 Soil Sampling

Soil samples will be collected during the drilling of monitoring well borings. The monitoring well borings will be continuously sampled from the surface to completion. One soil sample from each boring will be retained for laboratory analysis. The samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. One additional soil boring will be drilled to bedrock within the area of the 1996 soil excavation. Three soil samples will be collected from this boring: one immediately below ground surface, one between 4 and 5 feet below grade, and one immediately above bedrock. Soil samples retained for laboratory analysis will be tested for VOCs, SVOCs, TPH, and metals.

### 11.3.1.4 Surface Water Sampling

No surface water samples will be collected at SS 006 during the Basewide RI/FS.

### 11.3.1.5 Sediment Sampling

No sediment samples will be collected at SS 006 during the Basewide RI/FS.

## 11.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at SS 006 to provide quality control. The following QA/QC samples will be collected during the site investigation at SS 006:

- one duplicate water sample
- one duplicate soil sample

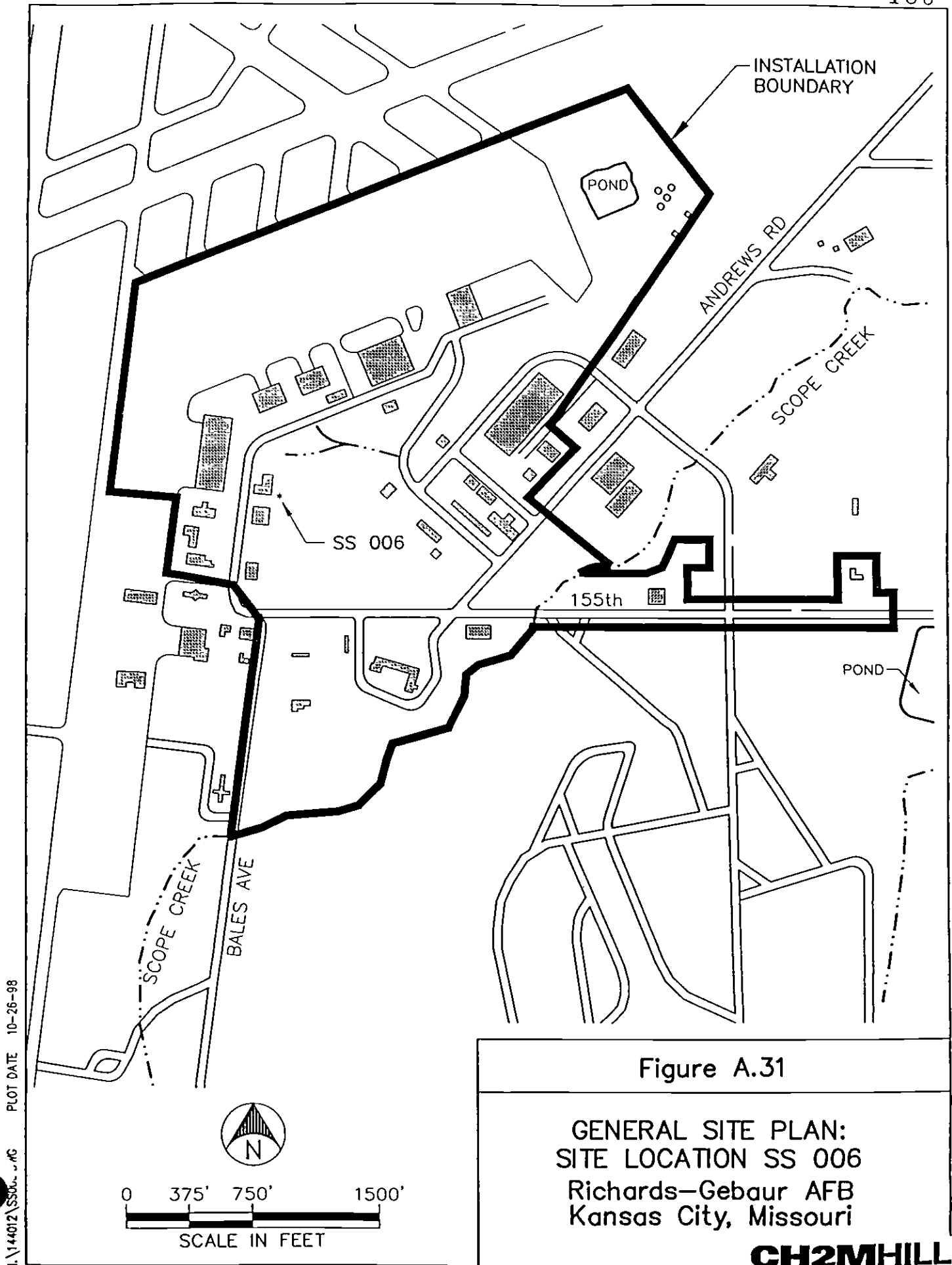
In addition to field duplicates, other QA/QC samples may be collected during the investigation at SS 006. These samples include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks

## 11.3.3 Laboratory Analyses

Table A-11 lists the analytical parameters for soil, groundwater, and associated QC samples.

**Table A-11 Summary of Sample Analyses - SS 006**

Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater <sup>1</sup>	4	√	√	√	√	
Soil	6	√	√	√	√	
<b>QA/QC Samples<sup>2</sup></b>						
Field Duplicate <sup>3</sup>	2	√	√	√	√	
Notes						
1 Groundwater samples will be analyzed for natural attenuation parameters (dissolved oxygen, redox, alkalinity, pH, conductivity, NO <sub>3</sub> <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , Fe <sup>2+</sup> , and Cl <sup>-</sup> )						
2 In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP.						
3 At least one field duplicate shall be collected for each sample medium						



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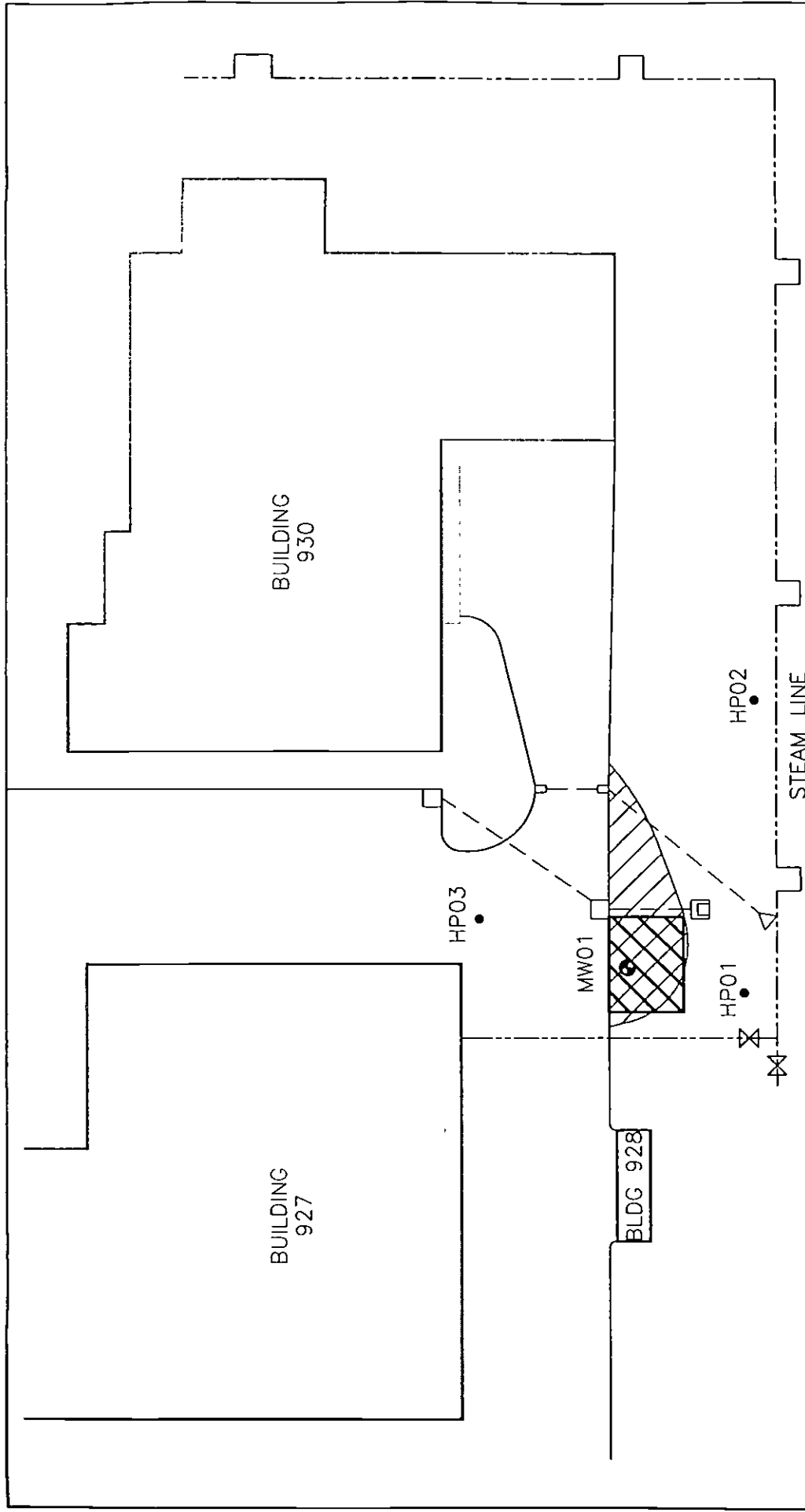






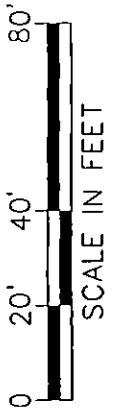
Figure A.32

MONITORING WELL LOCATIONS  
SITE SS 006

Richards-Gebaur AFB  
Belton, Missouri

LEGEND

-  LIMIT OF EXCAVATION
-  FORMER AREA OF STRESSED VEGETATION
-  DIRECT PUSH BORING LOCATION
-  MONITORING WELL

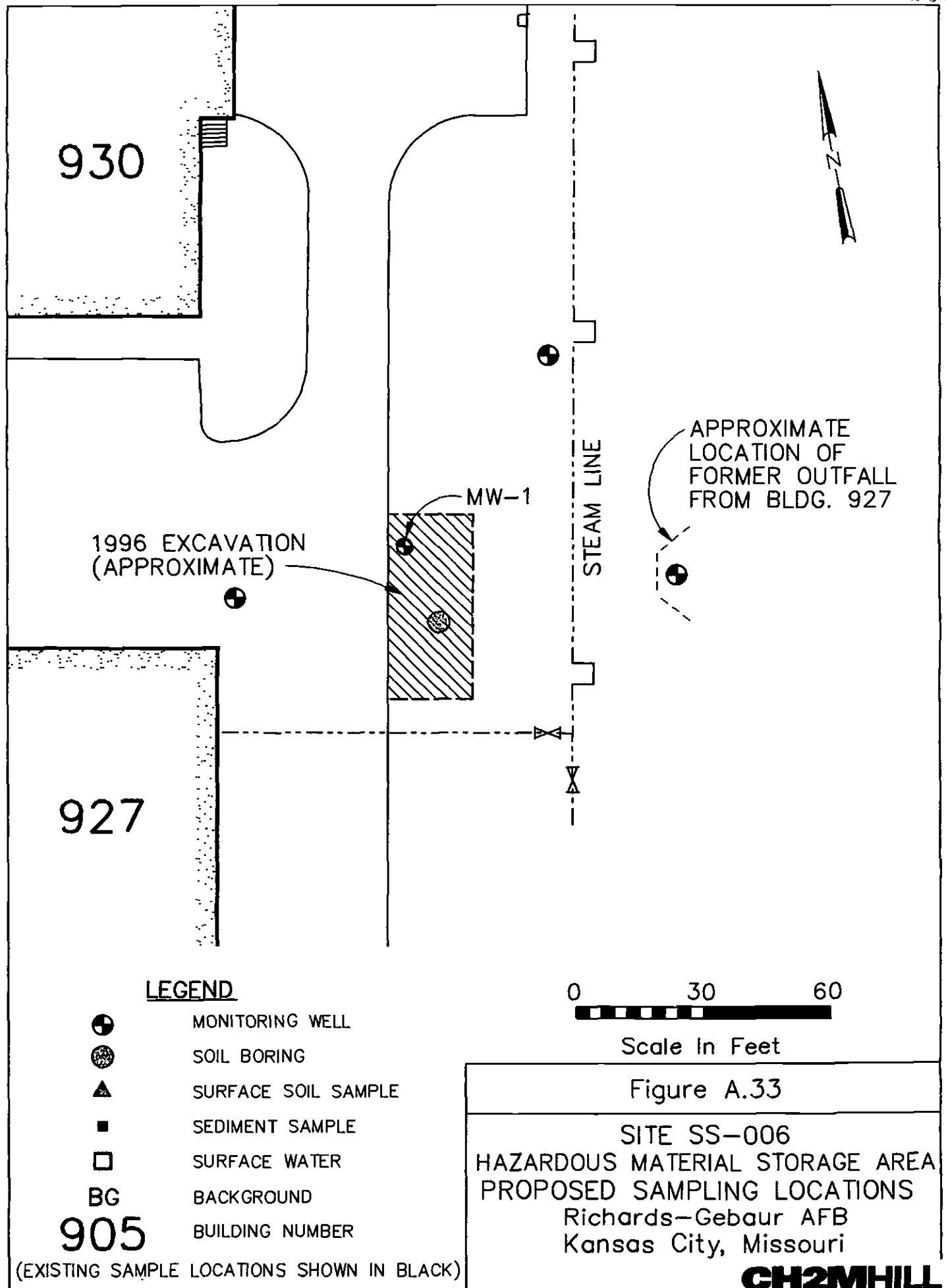




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## 12.0 SSP – SS 008

### Test Cell Area

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#### 12.1 Introduction

This site sampling plan describes the proposed sampling approach at SS 008. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

##### 12.1.1 Site Description

SS 008, the Test Cell Area, is located at north end of the flightline, northeast of Building 973, and southeast of Hangar Road. The site location is shown in **Figure A.34**. The area was used in the past for aircraft maintenance. According to previous investigations, the Test Cell Area consists of a narrow strip of grass approximately 100 feet long and 10 feet wide (Dames & Moore, 1996c). There are no buildings in the immediate vicinity of SS 008.

The site is flat and lies at one of the higher points on the Base. The site is underlain by about 20 feet of clay fill. The fill contains gravel and concrete fragments (Burns & McDonnell, 1993i). The site is not located in a floodplain and no surface water bodies or sediments exist onsite.

##### 12.1.2 Summary of Previous Investigation

SS 008 was used as an aircraft maintenance area. Operations such as washing, refueling, painting, and oil changing routinely took place at the site from 1956 to 1977 (Burns & McDonnell, 1993g). Accordingly, soaps, solvents, oils, and lubricants were used and stored at the site. After the designated use as a maintenance area was discontinued, waste materials were temporarily stored at the site pending later disposal (Burns & McDonnell, 1993g). Small spills of fuel in and around the area are suspected, based on field observations (Jacobs, 1995).

In 1991, a shallow trench was excavated for a new water line. Richards-Gebaur AFB personnel noticed a sheen of oil on some water that had seeped into low areas of the trench. In response to the situation, forty-two soil samples were collected as part of a Site Inspection (Burns & McDonnell, 1993g). Nineteen field soil samples and one grab water sample were collected subsequently in 1996 as part of a Remedial Investigation (Dames & Moore, 1996c).

Sampling locations during the previous site investigation are displayed in **Figure A.35**.

##### 12.1.3 Current Site Status

The site is bordered by concrete and asphalt pavement and currently is not used.

Additional characterization of the site is recommended to better evaluate whether the previously detected petroleum hydrocarbons are indicative of a larger hydrocarbon source, or simply represent an anomalous data point.

## 12.2 Chemicals of Concern

Because of the widespread use of petroleum products and detergents in the past, and the reported storage of used oil and other waste liquids, several COC are potentially related to the former Test Cell Area. These chemicals include TPH constituents, VOCs, SVOCs, and metals. Two episodes of soil and groundwater sampling have been performed to evaluate the potential extent and distribution of these chemicals at the site.

### 12.2.1 Soils

Soil samples were collected from SS 008 in 1993. The samples were analyzed for TPH, VOCs, and lead (Burns & McDonnell, 1993g). Forty-two samples were collected from 16 soil borings from depths ranging from 2 feet to 24 feet. The majority of the samples were collected within a 100-foot radius of the utility trench. None of the compounds were detected above applicable State action levels.

A second site investigation took place three years later. Nineteen soil samples and a grab water sample were collected from nine borings located along the former utility trench. The borings ranged in depth from ten feet to twelve feet (Dames & Moore, 1996c). The samples collected from the pipe trench area were analyzed for TPH GRO/DRO, VOCs, metals, and PCBs.

No VOCs, PCBs or metals were detected above action levels in any of the soil samples. TPH constituents were not detected above the State action level of 50 ppm in eighteen of nineteen samples. However one sample (RG3-SSSB-HA1) showed a TPH concentration of 240 ppm. This sample was collected apart from the other samples, on a different date, using a hand auger. The sample subsequently was also analyzed for SVOCs. Several SVOCs were detected slightly above 1996 State action levels for carcinogenic PAH compounds (previous ASL 0.44 ppm) in the soil sample: benzo(a)anthracene (1 ppm), chrysene (1.3 ppm), benzo(b)fluoranthene (1.2 ppm), benzo(k)fluoranthene (0.5 ppm), benzo(a)pyrene (0.9 ppm), and ideno(1,2,3-cd)pyrene (0.6 ppm). Based on current MDNR CALM guidance, only benzo(a)pyrene exceeds its corresponding CALM STARC concentration of 0.23 ppm for  $C_{DI}$ . Because the presence of PAH compounds is unsupported by other site data, it is likely that the PAH data is not representative of conditions at the Test Cell Area, and may be an artifact of the fill.

### 12.2.2 Groundwater

One grab water sample was retrieved from a soil sample location at a depth of between four to eight feet below ground surface. The sample was reportedly turbid. It was analyzed for TPH-DRO constituents only (Dames & Moore, 1996c). TPH constituents were detected at a concentration of 2,430 ppm.

The absence of shallow groundwater at the Test Cell site was shown by the eight dry borings advanced through fill soils. One boring was drilled to a depth of 29.5 feet, but remained dry. It is likely, therefore, that the groundwater collected and analyzed is an anomaly. It is not considered to be representative of subsurface conditions at the Test Cell Area that were otherwise reported as dry.

### 12.2.3 Surface Water and Sediments

No surface water or sediment samples were collected at the Test Cell site.

## 12.3 Objectives and Scope

The objectives of the site investigation at SS 008 are as follows:

- evaluate groundwater occurrence
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater

To meet these objectives, the following field activities will be conducted at SS 008:

- install one monitoring well
- measure groundwater elevation at the one new well
- collect groundwater sample from the new well
- collect three soil samples from the monitoring well boring
- analyze soil and groundwater samples for SVOCs and TPH

### 12.3.1 Field Methodologies

The field and analytical methodologies to be used at SS 008 are summarized below.

#### 12.3.1.1 Monitoring Well Installation

One new monitoring well will be installed at SS 008. The well will be drilled between 6 and 18 inches into the upper bedrock unit. The proposed well location, shown in **Figure A.36**, corresponds to the site of the former soil sample (HA-1—see **Figure A.35**) that recorded an elevated TPH concentration. The monitoring well location may be modified during the Basewide Remedial Investigation, depending on the location of underground utilities. The monitoring well will be installed and developed according to the procedures described in the FSP.

#### 12.3.1.2 Groundwater Sampling

One groundwater sample will be collected from the new monitoring well. A water level measurement will be made before sampling. Groundwater sampling procedures will follow the methodologies described in this FSP. The samples will be analyzed for SVOCs and TPH.

#### 12.3.1.3 Soil Sampling

Soil samples will be collected during the drilling of the monitoring well boring. The boring will be continuously sampled from the surface to completion. Three soil samples will be retained for laboratory analyses. The samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. The select samples will be analyzed for SVOCs and TPH.

#### 12.3.1.4 Surface Water Sampling

No surface water samples will be collected at SS 008 during the Basewide RI/FS.

#### 12.3.1.5 Sediment Sampling

No sediment samples will be collected at SS 008 during the Basewide RI/FS.

### 12.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at SS 008 to provide quality control. The following QA/QC samples will be collected during the site investigation at SS 008:

- one duplicate groundwater sample
- one duplicate soil sample

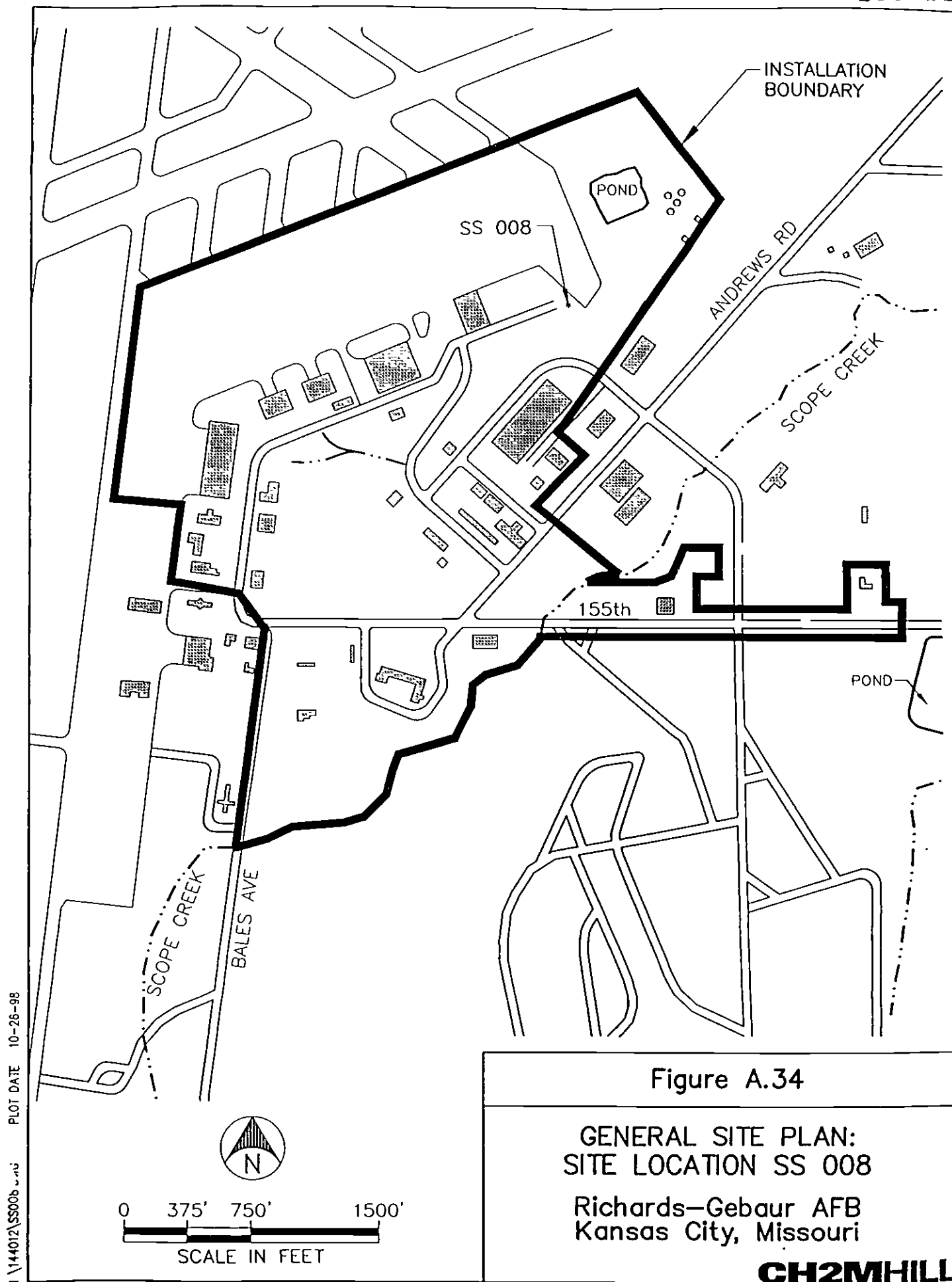
In addition to field duplicates, other QA/QC samples may be collected during the investigation at SS 008. These samples include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

### 12.3.3 Laboratory Analyses

**Table A-12** lists the analytical parameters for soil, groundwater, and associated QC samples.

**Table A-12 Summary of Sample Analyses - SS 008**

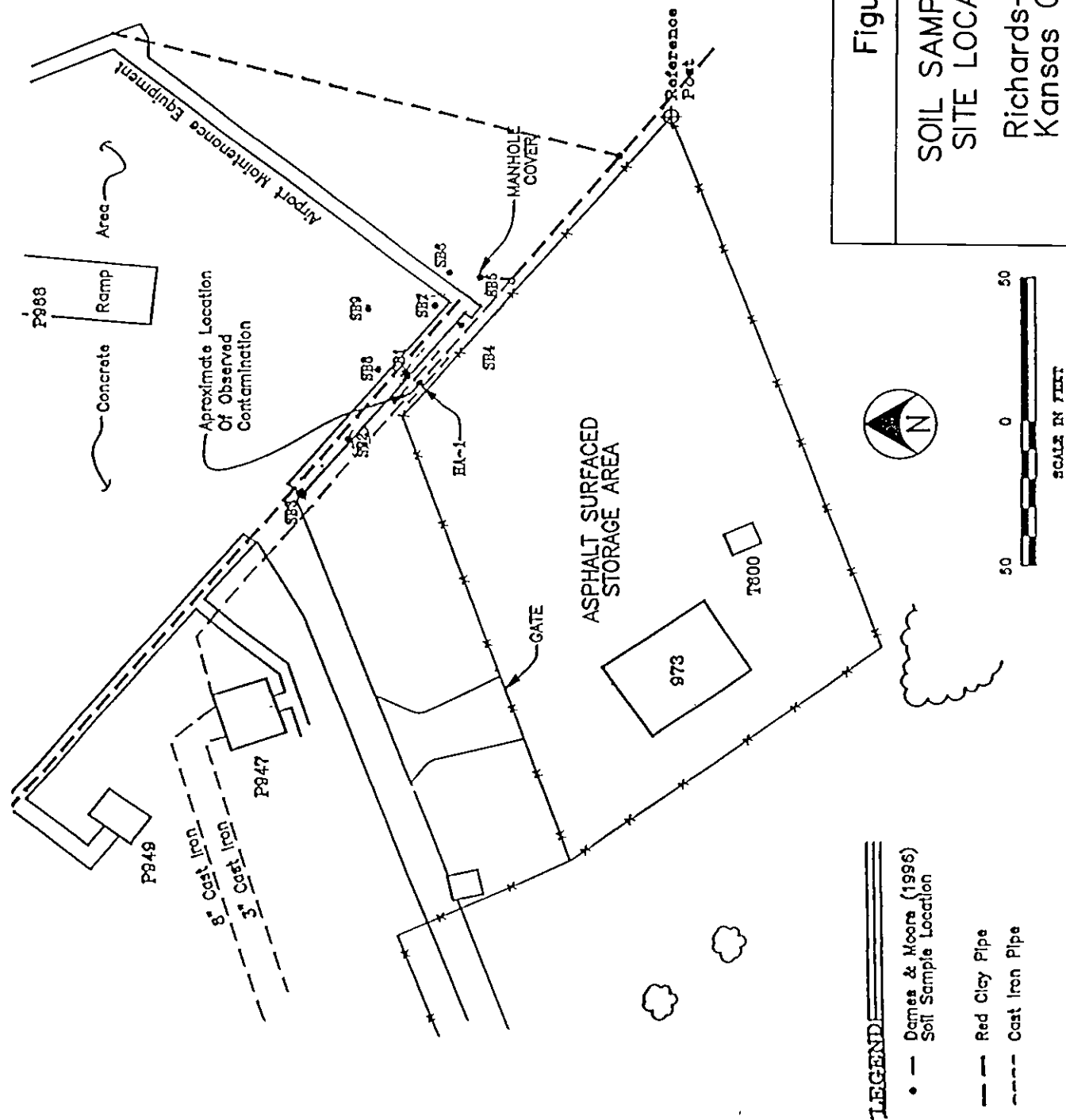
Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Sample</b>						
Groundwater	1		√	√		
Soil	3		√	√		
<b>QA/QC Sample<sup>1</sup></b>						
Duplicate <sup>2</sup>	2		√	√		
<b>Notes</b> 1 In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP. 2 At least one field duplicate shall be collected for each sample medium						



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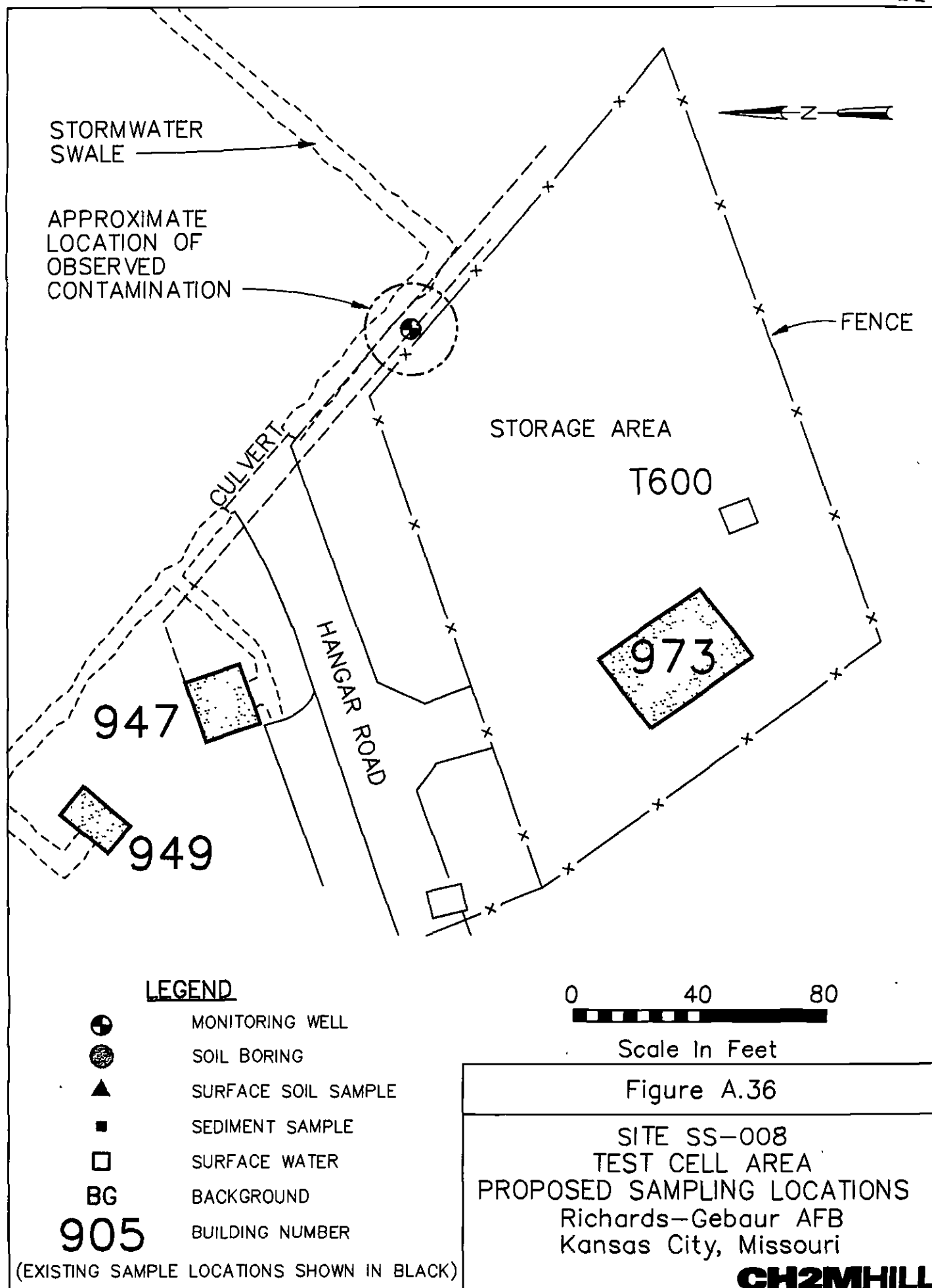
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## 13.0 SSP – SS 009

### Fire Valve Area

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#### 13.1 Introduction

This site sampling plan describes the proposed sampling approach at SS 009. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

##### 13.1.1 Site Description

SS 009 is located on Richards-Gebaur AFB directly on the southwest side of Building 605 on Corkill Road, southeast of the intersection of Westover and Corkill Roads (**Figure A.37**). Building 605 was used by the Air Force as part of the Civil Engineering Complex from 1953 to 1996. The building was used for various purposes during this period, including a Carpenter Shop, Interior and Exterior Heat Shop, Roads and Grounds Shop, and Sanitation Shop (Tetra Tech, 1995c). Reportedly, no activities at the complex involved the storage or handling of bulk hazardous waste materials (USAF, 1993).

The site is located on the far side of a paved parking lot next to a fire valve and adjacent to a small grass drainage swale. It occupies approximately 400 square feet in area and is generally flat. The site is not located in a floodplain.

##### 13.1.2 Summary of Previous Investigations

The site was initially identified in 1992 when petroleum product was reported by an Air Force contractor who was digging a ditch to repair an underground water main valve (USAF, 1993). As a consequence, approximately 10 cubic yards of petroleum-contaminated soil was excavated from the water line trench to a depth of approximately five feet below ground surface in 1993. The limit of soil excavation is depicted in **Figure A.38**.

In 1994, a total of 70 soil samples were collected from the site for possible laboratory analyses during a PA/SI (Tetra Tech, 1995c). A groundwater assessment was conducted at the site to evaluate the potential adverse impacts to local shallow groundwater (Versar, 1996a).

##### 13.1.3 Current Site Status

The Civil Engineering Complex is no longer in use. The petroleum-contaminated soil has been removed from the site in accordance with *MDNR Underground Storage Tank Closure Guidance Document* (MDNR, 1996). The site was backfilled with clean material and returned to grade.

#### 13.2 Chemicals of Concern

The COC at the Fire Valve site are petroleum hydrocarbons and chlorinated hydrocarbons. Constituents of both these chemical groups have been detected at the site.

### 13.2.1 Soil

Reportedly, petroleum product was noticed during an excavation to repair a water main valve. In response, ten cubic yards of soil was removed from the Fire Valve Area, to a depth of approximately five feet below ground surface. The excavated soil was tested for BTEX and TPH. The results indicated that xylenes (28 ppm) and TPH (24,870 ppm) exceeded the applicable State of Missouri's action levels for these chemicals of 10 ppm and 50 ppm, respectively (Tetra Tech, 1995c). Post-excavation samples were not collected.

To assess if the affected soil had been removed from the Fire Valve Area, a PA/SI was conducted. Twenty-two soil borings were drilled and 70 soil samples were collected at depths up to 15 feet below ground. The samples were field screened for VOCs using a field gas chromatograph (GC). Seventeen soil samples were submitted for laboratory analysis. The samples were tested for TPH-GRO, TPH-DRO, VOCs, and SVOCs (Tetra Tech, 1995c). The DRO constituents of TPH were detected above the State action level for TPH of 50 ppm in one of 17 samples, at a concentration of 370 ppm. However, GRO constituents were not detected in any samples. Furthermore, VOCs and SVOCs were not detected above currently applicable CALM STARC  $C_{ID1}$  and  $C_{leach}$  values in any samples.

### 13.2.2 Groundwater

A preliminary groundwater assessment was conducted at the site in 1996 (Versar, 1996a). Three temporary wells were installed to depths from 14 feet to 18 feet below ground surface. One temporary well, PZ-03, could not be sampled because of insufficient groundwater volume for the required analyses. Groundwater samples were collected from the remaining two wells and analyzed for TPH constituents, VOCs, SVOCs, metals, and PCBs.

No TPH constituents were detected in the samples. No SVOCs were detected above applicable MCLs. Four VOCs were detected with concentrations that exceeded their respective MCLs. The VOCs detected were 1,1-dichloroethene (17 ppb, 16 ppb), tetrachloroethene (12 ppb, 33 ppb), trichloroethene (8.8 ppb, 11 ppb), and vinyl chloride (4.6 ppb, 21 ppb).

Several metals were also detected in the total metals analysis at concentrations above their respective MCLs. The metals detected included arsenic (63.1 ppb), barium (5,240 ppb), cadmium (5.3 ppb), chromium (157 ppb, 227 ppb), and lead (56.4 ppb, 184 ppb). The dissolved metals analytical results, however, were all below the applicable MCLs. PCB results are considered inconclusive because the detection limit of 1.1 ppb was higher than the corresponding MCL of 0.5 ppb.

## 13.3 Objectives and Scope

The objectives of the site investigation at SS 009 are as follows:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater
- evaluate potential for natural attenuation at the site

To meet these objectives, the following field activities will be conducted at SS 009:

- install three monitoring wells
- measure groundwater elevations at the three new wells
- collect groundwater samples from the three new wells
- collect three soil samples from the monitoring well borings
- analyze soil and groundwater samples for VOCs, SVOCs, TPH, metals, and PCBs
- analyze groundwater samples for natural attenuation parameters

### **13.3.1 Field Methodologies**

The field and analytical methodologies to be used at SS 009 are summarized below.

#### **13.3.1.1 Monitoring Well Installation**

Three new monitoring wells will be installed at SS 009. The wells will be drilled between 6 and 18 inches into the upper bedrock unit. The proposed well locations are shown in **Figure A.39**. The monitoring well locations may be modified during the Basewide Remedial Investigation, depending on the location of underground utilities. The monitoring wells will be installed and developed according to the procedures described in the FSP.

#### **13.3.1.2 Groundwater Sampling**

Groundwater samples will be collected from each of the three new monitoring wells. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs, SVOCs, TPH, metals, PCBs, and natural attenuation parameters.

#### **13.3.1.3 Soil Sampling**

Each monitoring well boring will be continuously sampled from the surface to completion. One soil sample from each boring will be retained for laboratory analyses. The samples will be selected based upon the results of field screening and at the judgement of the field geologist. The selected samples will be analyzed for VOCs, SVOCs, TPH, metals, and PCBs.

#### **13.3.1.4 Surface Water Sampling**

No surface water samples will be collected at SS 009 during the Basewide RI/FS.

#### **13.3.1.5 Sediment Sampling**

No sediment samples will be collected at SS 009 during the Basewide RI/FS.

### **13.3.2 Quality Assurance/Quality Control (QA/QC)**

In accordance with the project QAPP, additional samples will be collected at SS 009 to provide quality control. The following QA/QC samples will be collected during the site investigation at SS 009

- one duplicate groundwater sample
- one duplicate soil sample

In addition to field duplicates, other QA/QC samples may be collected during the investigation at SS 009. These samples include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

### 13.3.3 Laboratory Analyses

**Table A-13** lists the analytical parameters for soil, groundwater, and associated QC samples.

**Table A-13 Summary of Sample Analyses - SS 009**

Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater <sup>1</sup>	3	√	√	√	√	√
Soil	3	√	√	√	√	√
<b>QA/QC Samples<sup>2</sup></b>						
Duplicate <sup>3</sup>	2	√	√	√	√	√
<b>Notes</b> 1. Groundwater samples will be analyzed for natural attenuation parameters (dissolved oxygen, redox, alkalinity, pH, conductivity, NO <sub>3</sub> <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , Fe <sup>2+</sup> , and Cl <sup>-</sup> ). 2. In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP. 3. At least one field duplicate shall be collected for each sample medium.						

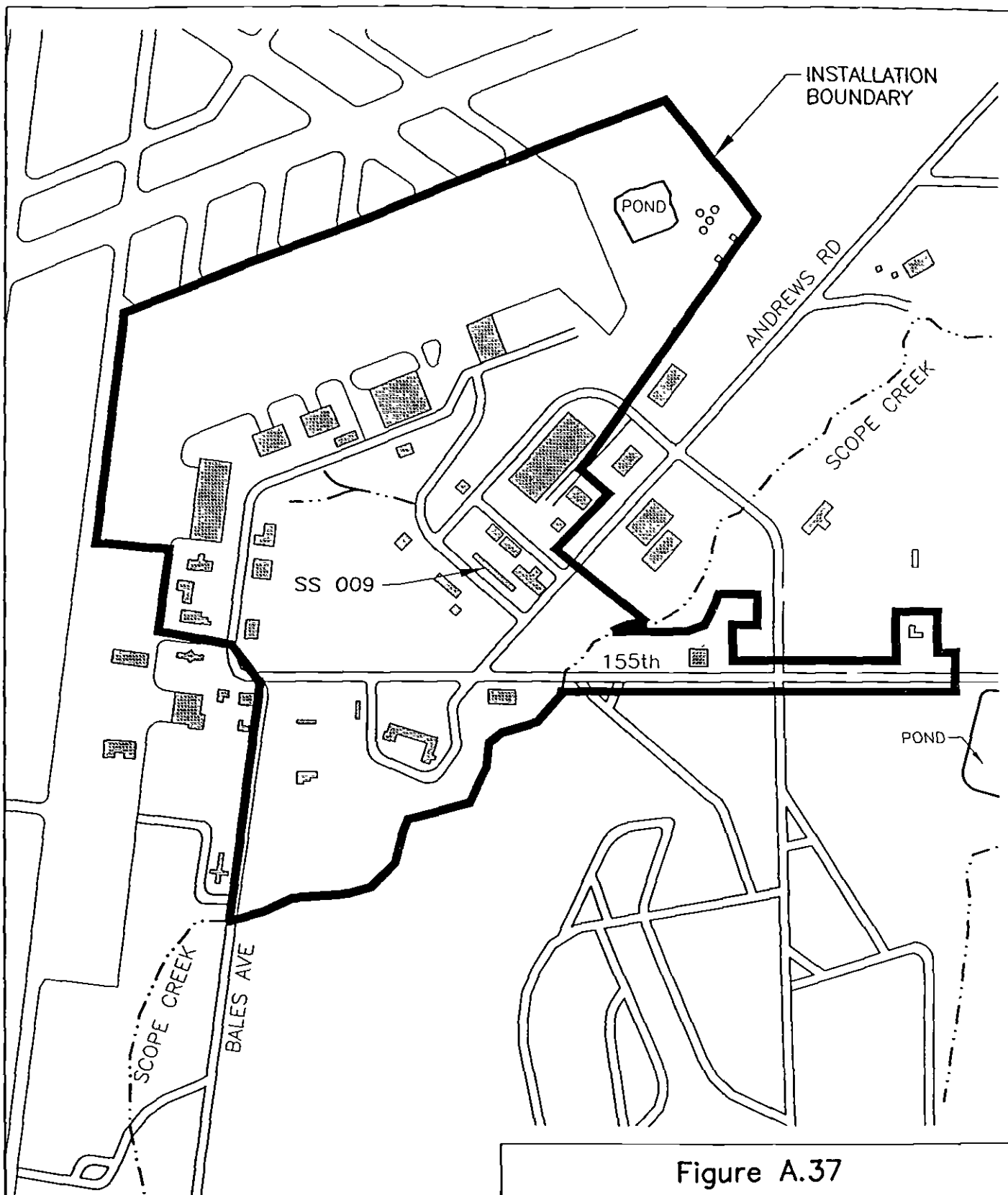


Figure A.37

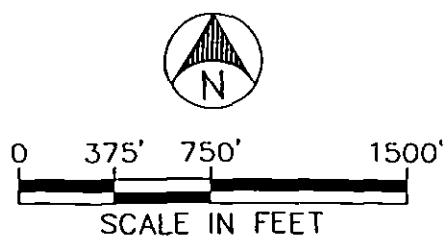
GENERAL SITE PLAN:  
SITE LOCATION SS 009

Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

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AFTER VERSAR INC., 1996

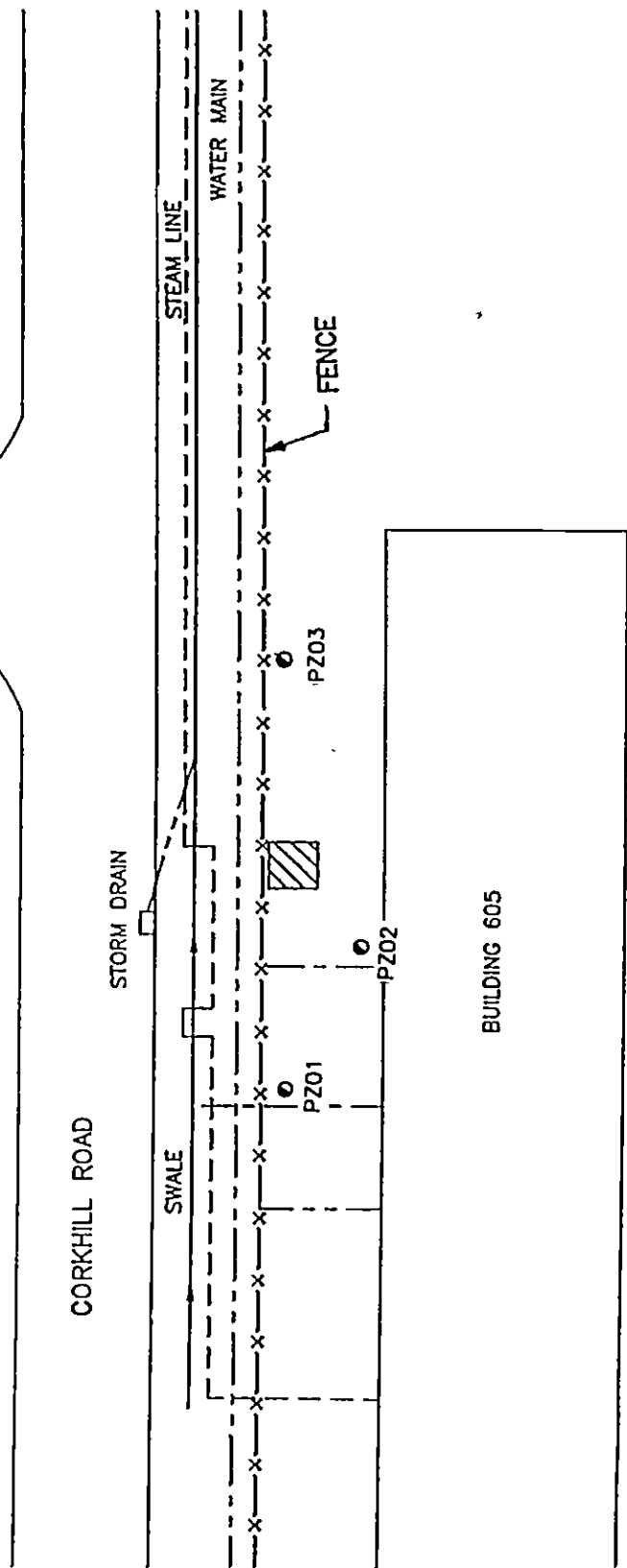




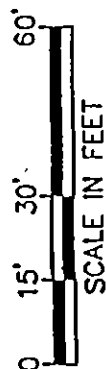
Figure A.38

SITE LAYOUT &  
LIMITS OF EXCAVATING  
SITE LOCATION SS 009  
Richards--Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

LEGEND

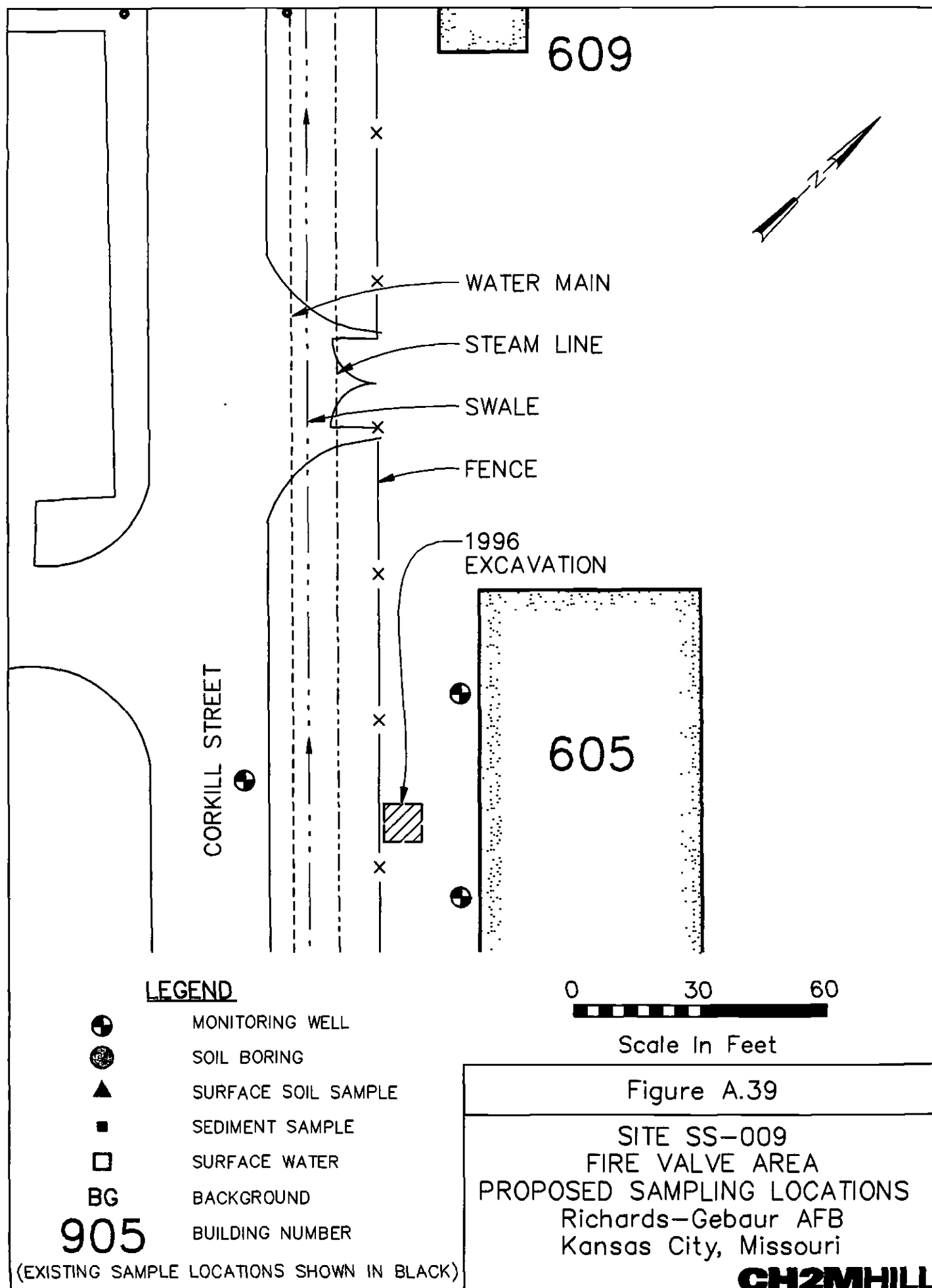
-  LIMITS OF EXCAVATION
-  TEMPORARY WELL



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## 14.0 SSP – ST 005

### POL Yard

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#### 14.1 Introduction

This site sampling plan describes the proposed sampling approach at ST 005. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

##### 14.1.1 Site Description

ST 005, the Petroleum, Oil, and Lubricants (POL) storage yard is a former aboveground tank farm located east of the flight line and west of Andrews Road (**Figure A.40**). The POL Yard is 12 acres in size and was in use from 1954 to 1988. The POL Yard was used to store and dispense jet fuel (JP-4), fuel oil and motor gasoline (MOGAS) to the Base. Most of the structures formerly at the site were removed in 1996. The only remaining structures are the former AST (Facility 956) and a Pump House (Facility 959).

##### 14.1.2 Summary of Previous Investigations

The POL Yard began operations in 1954. In 1985, an aboveground storage tank (Facility 956) and a pump house (Facility 959) were sold to the City of Kansas City, and remain in place today. The POL Yard was decommissioned in 1996. The following structures, including underground piping and piping headers, were demolished and removed from the POL Yard in 1996 (Dames & Moore, 1996d):

Facility 954	260,000 gal. Heating oil AST
Facility 955	187,000 gal. JP-4 AST
Facility 957	210,000 gal. JP-4 AST
Facility 951	Boiler Building
Facility 953	Fuel Pump House
Facility 960	Fuel Pump House
Facility 952	Truck Fill Stand

Two former hydrant fuel systems were used to distribute fuel from the POL Yard to the flightline USTs. One system transported aviation gasoline (AVGAS) and, later, JP-4 fuel to a truck fuel stand (Facility 941) located approximately 1,200 feet west of the POL Yard at the east end of the flightline. The second system transported JP-4 fuel to the four former USTs at Building 902 (ST 007), which provided fuel to six flightline fueling stations or pits (AOC 006). The layout of the POL Yard is shown in **Figure A.41**



### 14.1.3 Current Site Status

The POL Yard was decommissioned in 1986. It is currently in disuse and fenced. All fueling structures have been removed except for the remaining AST and the abandoned Pump House.

## 14.2 Chemicals of Concern

The POL Yard stored and distributed petroleum fuel products. The contaminants of concern, therefore, are those chemicals commonly associated with fuel depots: TPH constituents, BTEX, PAH constituents, and lead. These COCs have been detected onsite during several site investigations conducted from 1989 to 1996.

### 14.2.1 Soil

Numerous soil investigations have been performed at the POL Yard to evaluate the nature and extent of potential petroleum contamination. The work is summarized as follows:

- 1986 - three boreholes were drilled within each of the three AST berms (Facilities 954, 955, and 957). Three samples were collected from each boring. In addition, one surface soil sample was collected from outside of Facility 961; and a soil-boring sample was collected from a depth of 3 feet near Building 953 (Ecology and Environment, 1988).
- 1989 - three ten-foot deep soil borings were drilled and sampled at the POL Yard (O'Brien & Gere, 1991b)
- 1989 - 43 surface soil samples were collected from the POL Yard; five samples were collected from within each of three bermed areas surrounding the ASTs (Facilities 954, 955, and 957); three samples were collected from near Facility 953; one sample was taken at the fuel off-loading station; and three samples were collected from each of eight rail car tanker off-loading stations (USACE, 1989).
- 1991 – IRP Remedial Investigation: 4 soil samples were collected from four monitoring well borings (Burns & McDonnell, 1992c).
- 1996 - Phase I Removal Action and Phase II Site Characterization were conducted at the site. Site activities included demolishing the POL structures; collecting 40 soil samples from approximately 3,750 feet of excavated piping runs; collecting 424 soil samples from 136 borings; and excavating approximately 200 cubic yards of soil and site debris (Dames and Moore, 1996a and 1996b)

Soils samples collected during these investigations were analyzed for TPH constituents, BTEX compounds, VOCs, SVOCs, and metals. The majority of soil analytical data was generated during the 1996 POL Yard Removal Action that demolished the majority of site structures and removed the subsurface pipelines

The twelve soil samples during the initial investigation in 1988 revealed TPH concentrations from 6.9 ppm to 2,800 ppm (Ecology and Environment, 1988). In the 1989 USACE study, TPH concentrations in surface soil samples were reported from non-detected to 8,568 ppm, with seven samples exceeding 500 ppm (USACE, 1989)

The 1989 RI did not analyze soil samples for TPH, but analyzed for VOCs, SVOCs and metals. The results included three detections of acetone at concentrations of 12 ppb, 18 ppb, and 33 ppb. However, acetone was also detected in the laboratory method blank (O'Brien & Gere,

1991). In a second RI conducted in 1991, ethylbenzene, toluene, and xylenes were detected at concentrations below currently applicable CALM STARC values (Burns & McDonnell, 1992c).

During the 1996 removal action, 424 soil samples were collected from 136 borings. Of these, 355 samples were analyzed for BTEX, TPH, SVOCs and lead. Thirty-one soil samples had TPH concentrations above the CALM STARC level for commercial land use of 500 ppm, ranging from 568 ppm to 5,640 ppm. In 1997, a single soil sample collected from 15 feet deep at well location MW 3D, about 200 feet southeast of the POL Yard, had a TPH concentration of 1,710 ppm. The extent of the contamination is unknown. BTEX constituents were either undetected in soil samples or present at levels below their respective CALM STARC values.

SVOCs concentrations were detected above MDNR STARC levels in samples taken from within the former bermed AST areas. Of 355 soil samples analyzed for SVOCs as part of the 1996 investigation, twenty-one samples exceeded State benzo(a)pyrene  $C_{ID1}$  level of 0.23 ppm; seven samples exceeded benzo(a)anthracene State  $C_{ID1}$  level of 1.5 ppm; three samples exceeded benzo(b)fluoranthene State  $C_{ID1}$  level of 1.4 ppm; and four samples were detected with concentrations of dibenzo(a, h)anthracene above its corresponding State  $C_{ID1}$  value of 0.21 ppm. Only one sample contained concentrations of ideno(1,2,3,cd)pyrene that exceeded the corresponding State  $C_{ID1}$  level of 4.2 ppm.

## 14.2.2 Groundwater

Four investigations of the groundwater quality and occurrence at the POL Yard have been performed. The investigations are summarized as follows:

- 1986 - a single monitoring well was installed and sampled topographically downgradient of the POL Yard perimeter (Ecology and Environment, 1988)
- 1989 - four more monitoring wells were installed and sampled (wells #1205, #1206, #1207, and #1208). Well 1205 was installed downgradient of the POL Yard and well 1206 was installed upgradient of the POL Yard (O'Brien & Gere, 1990)
- 1991 - four additional monitoring wells were installed and sampled (MW-1, MW-2, MW-3, and MW-9) at the site (Burns & McDonnell, 1992c)
- 1996 - eight monitoring wells were installed east of the POL Yard to investigate potential migration of COC offsite. The wells were identified as MW-1S, MW-2D, MW-3S, MW-3D, MW-4D, MW-5D, MW-7S, and MW-8S (Dames & Moore, 1996d).

At present, seventeen groundwater-monitoring wells are installed to monitor groundwater at the POL Yard. Most of the wells are screened above bedrock, but four of the 1996 wells were completed into the underlying shale and limestone bedrock. The well locations are shown in **Figure A.42**. Thirteen of the wells have been installed to depths ranging from approximately 12 feet to 22 feet below ground level to monitor the unconsolidated materials. Four of the wells have been installed to depths ranging from approximately 32 feet to 40 feet to monitor groundwater that may occur in the bedrock. Bedrock monitoring wells are located south and offsite from the POL Yard

Groundwater samples from POL Yard wells have been analyzed for TPH constituents, BTEX compounds, VOCs, SVOCs, and metals. In 1986, concentrations of TPH and VOCs in a groundwater sample collected from the site were below detection limits. The 1989 investigation also analyzed groundwater samples for TPH, VOCs, and metals, and reported concentrations of benzene, lead, barium, and chromium above applicable MCLs. Nine additional groundwater samples were collected in 1991. Trichloroethene (TCE) was detected in a single groundwater

sample collected from well MW-3. The compound was not detected in any other groundwater samples. The sample had a TCE concentration of 44.4 ppb, above the corresponding TCE MCL of 5.0 ppb. However, TCE was also reported in the associated trip blank at an estimated concentration of 0.6 ppb. Therefore, the existence of TCE is unconfirmed.

The 1996 study collected groundwater samples from the eight newly installed monitoring wells, analyzing them for TPH, BTEX, SVOCs, and lead. In addition, a grab groundwater sample was collected from each of two soil borings. Benzene was reported at a concentration of 5.1 ppb in bedrock monitoring well MW5D, and at 8.6 ppb in the soil boring MW-4S. Benzene was the only contaminant detected in samples from bedrock wells. Although reported benzene levels do not exceed the MDNR UST action level for non-potable water of 50 ppb, the concentrations did exceed the MDNR and EPA MCL of 5 ppb for potable groundwater supplies.

### **14.2.3 Surface Water**

Two surface water samples were collected from the drainage ditch west of the POL Yard during the initial 1986 investigation (Ecology and Environment, 1988). One sample was collected upstream of the POL Yard and one was collected from a downstream location. No petroleum hydrocarbons, VOCs, or metals were detected.

## **14.3 Objectives and Scope**

The objectives of the site investigation at ST 005 are as follows:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in soils immediately east of the POL yard boundary
- evaluate presence and concentration of COC in groundwater
- evaluate potential for natural attenuation at the site

To meet these objectives, the following field activities will be performed at ST 005:

- advance five soil borings in the vicinity of MW-3D, retaining four samples from each boring for laboratory analyses
- advance two soil borings from a former concrete debris pile area east of MW-3D, retaining three samples from each boring for laboratory analyses
- replace existing well MW-1208, to be abandoned by Dames & Moore, with a new monitoring well
- measure groundwater elevations in 17 monitoring wells
- collect groundwater samples from the 17 monitoring wells
- analyze soil and groundwater samples for VOCs, SVOCs, TPH, and metals
- analyze groundwater samples for natural attenuation parameters

### **14.3.1 Field Methodologies**

The field and analytical methodologies to be used at ST 005 are summarized below.

#### 14.3.1.1 Monitoring Well Installation

One monitoring well will be installed at ST 005 to replace existing well MW-1208, which will be abandoned by Dames & Moore. The proposed location of the replacement well is shown in **Figure A.43**. The well will be drilled between 6 and 18 inches into the upper bedrock unit. The monitoring well will be installed and developed according to the procedures described in the FSP.

#### 14.3.1.2 Groundwater Sampling

Groundwater samples will be collected from 17 monitoring wells, including the replacement well for MW-1208. Monitoring well locations are shown in **Figure A.43**. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for VOCs, SVOCs, TPH, metals, and natural attenuation parameters.

#### 14.3.1.3 Soil Sampling

Five soil borings will be drilled around existing monitoring well MW-3D. Each boring will be continuously sampled from surface to a planned depth of 20 feet below ground surface (bgs). If evidence of contamination is observed at 20 feet bgs, the boring will continue to bedrock (approximately 35 feet deep). One boring will be located within five feet of MW-3D, while the other four borings will be located no further than 25 feet radially from MW-3D. Soil boring locations are shown in **Figure A.43**. The horizon of interest corresponds to 15 feet below ground surface (bgs), where an elevated TPH concentration was measured in the soil boring for MW-3D. To further investigate this result, soil samples will be retained for laboratory analyses from the following depth intervals: 3 – 5 feet, 8 – 10 feet, 13 – 15 feet, and 18 – 20 feet bgs. Additional samples may be collected, at the discretion of the field geologist, if the borings are advanced beyond 20 feet bgs. The soil samples will be analyzed for VOCs, SVOCs, TPH, and metals.

In addition to the five borings described above, two soil borings will be completed east of MW-3D in an area that was formerly covered with concrete debris (**Figure A.43**). Each of the borings will be continuously sampled from surface to the upper bedrock unit. Three samples from each boring will be retained for laboratory analysis. The samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. The samples will be analyzed for VOCs, SVOCs, TPH, and metals.

#### 14.3.1.4 Surface Water Sampling

No surface water samples will be collected at ST 005 during the Basewide RI/FS.

#### 14.3.1.5 Sediment Sampling

No sediment samples will be collected at ST 005 during the Basewide RI/FS.

### 14.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at ST 005 to provide quality control. The following QA/QC samples will be collected during the site investigation at ST 005:

- two duplicate groundwater samples
- three duplicate soil samples

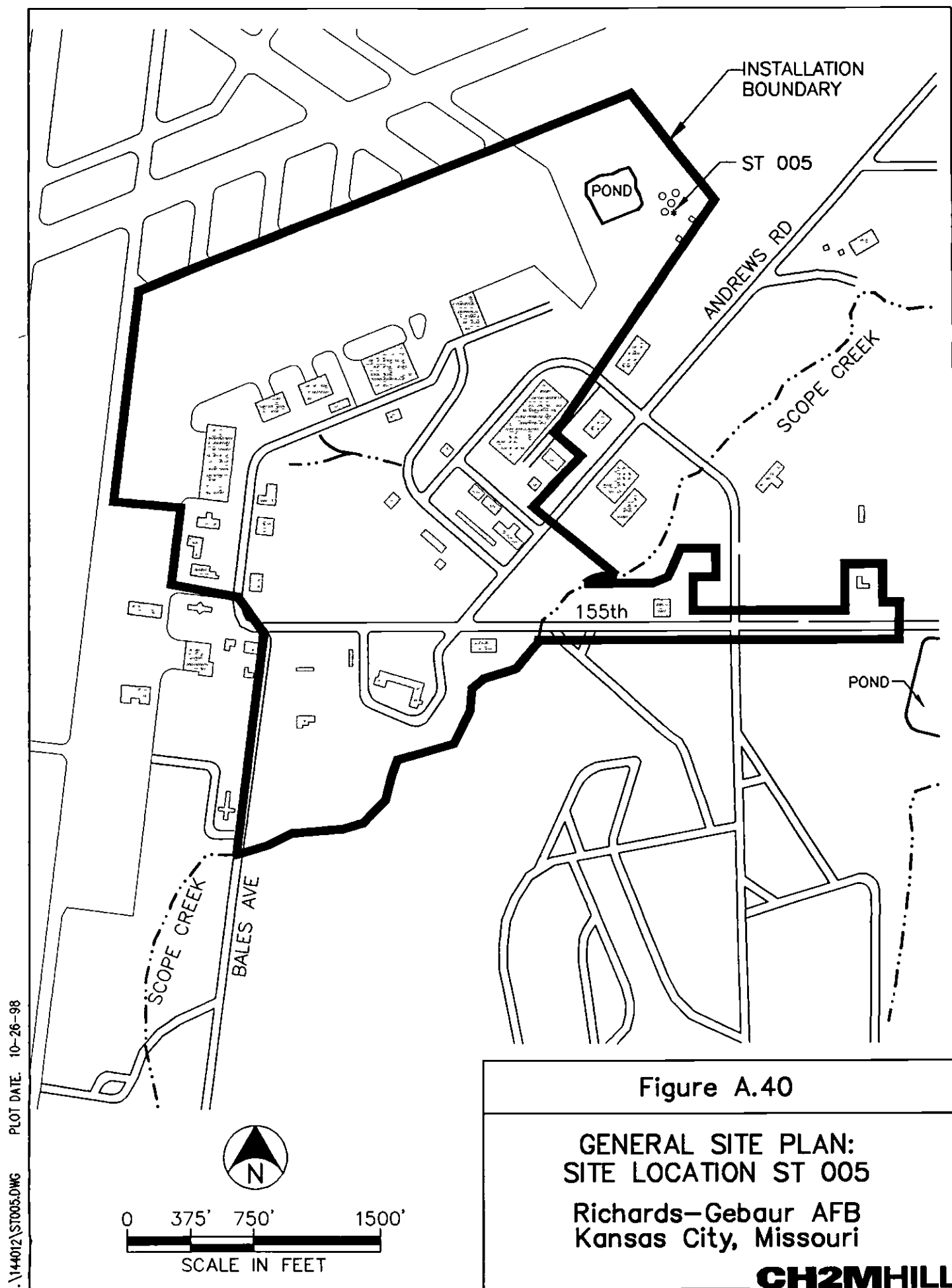
In addition to field duplicates, other QA/QC samples may be collected during the investigation at ST 005. These samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks.

### 14.3.3 Laboratory Analyses

**Table A-14** lists the analytical parameters for soil, groundwater, and associated QC samples.

**Table A-14 Summary of Sample Analyses - ST 005**

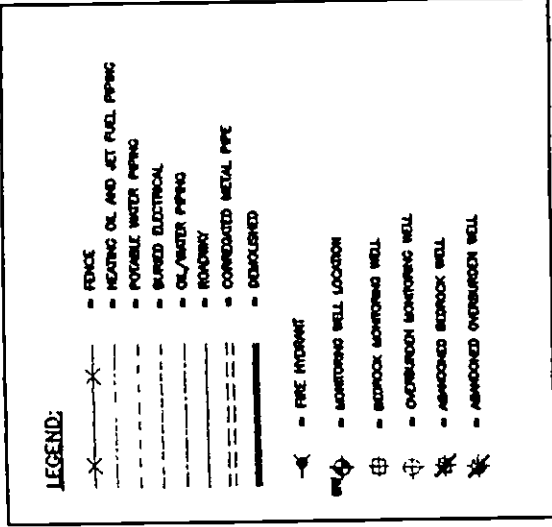
Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater <sup>1</sup>	17	√	√	√	√	
Soil	26	√	√	√	√	
<b>QA/QC Samples<sup>2</sup></b>						
Field Duplicates <sup>3</sup>	5	√	√	√	√	
<b>Notes</b> 1 Groundwater samples will be analyzed for natural attenuation parameters (dissolved oxygen, redox, alkalinity, pH, conductivity, NO <sub>3</sub> <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , Fe <sup>2+</sup> , and Cl <sup>-</sup> ) 2 In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP 3 At least one field duplicate shall be collected for each sample medium						



PLOT DATE: 10-26-98

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AFTER VERSAR INC., 1996



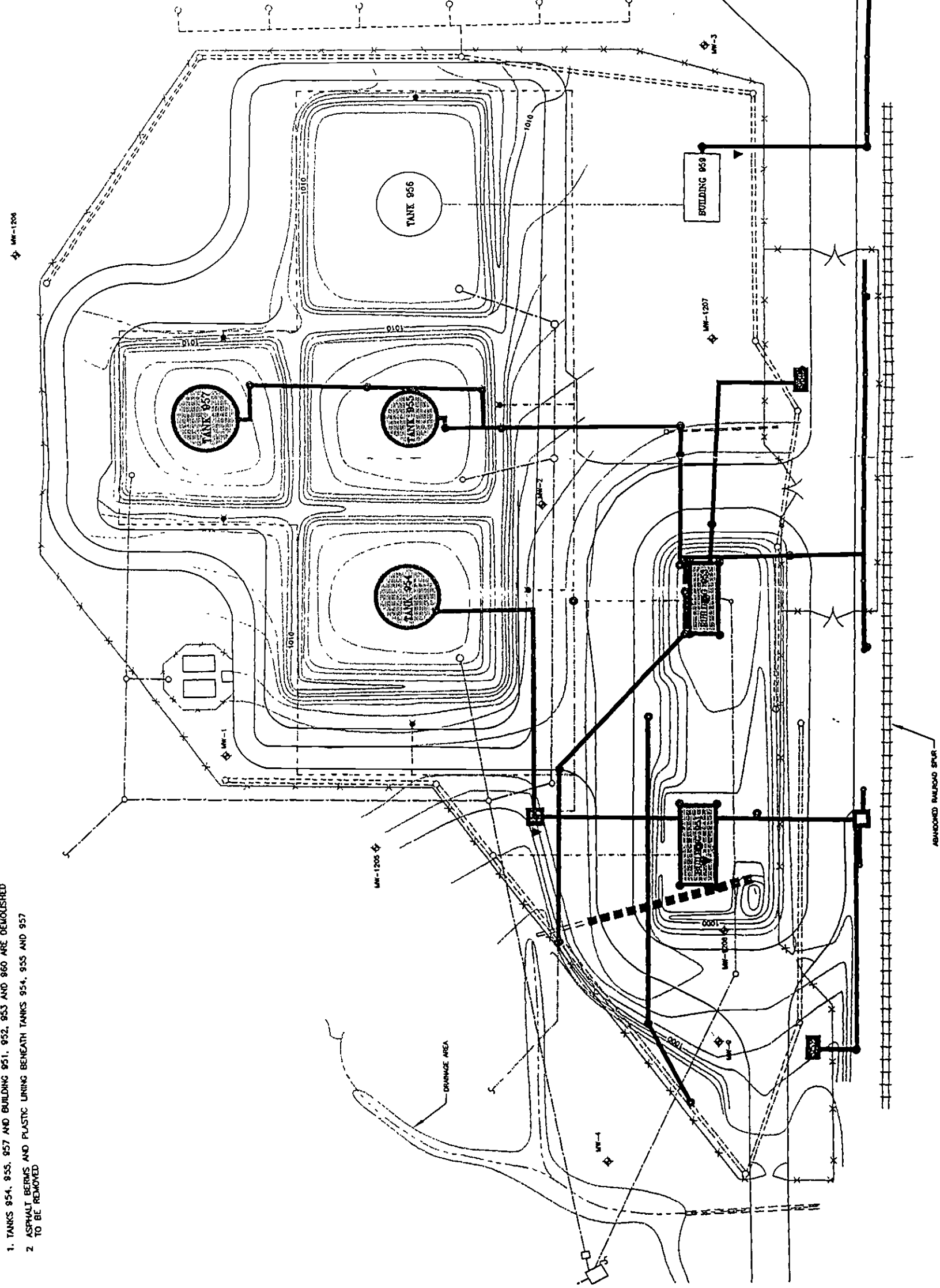
# MONITORING WELL LOCATIONS SOUTH OF POL YARD

Richards—Gebaur AFB  
Kansas City, Missouri

# ANDREWS ROAD

NOTES.

- 1. TANKS 954, 955, 957 AND BUILDING 951, 952, 953 AND 960 ARE DEMOLISHED
- 2. ASPHALT BEAMS AND PLASTIC LINING BENEATH TANKS 954, 955 AND 957 TO BE REMOVED



LEGEND.	
—X—	- FIRE HYDRANT
⊙	- PHASE I SAMPLE LOCATION
⊕	- MONITORING WELL
▼	- PHASE I GRAB WATER SAMPLE
---	- UNDERGROUND ELECTRICAL CONDUIT
-X-	- FENCE
-X-	- HEATING OIL AND JET FUEL PIPING
-X-	- POTABLE WATER PIPING
-X-	- OIL/WATER PIPING
-X-	- ROADWAY
-X-	- CORROGATED METAL PIPE
-X-	- DEMOLISHED

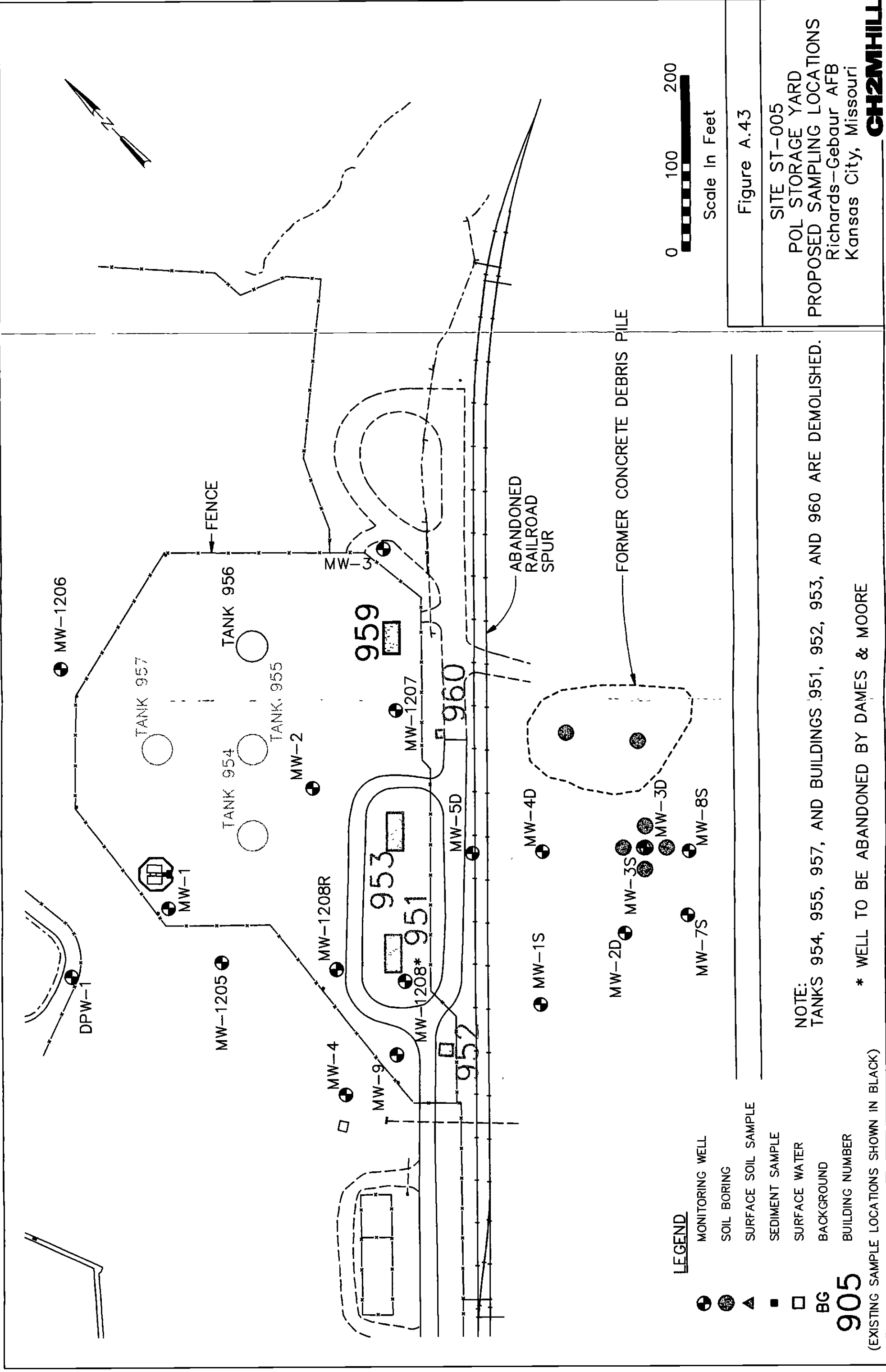
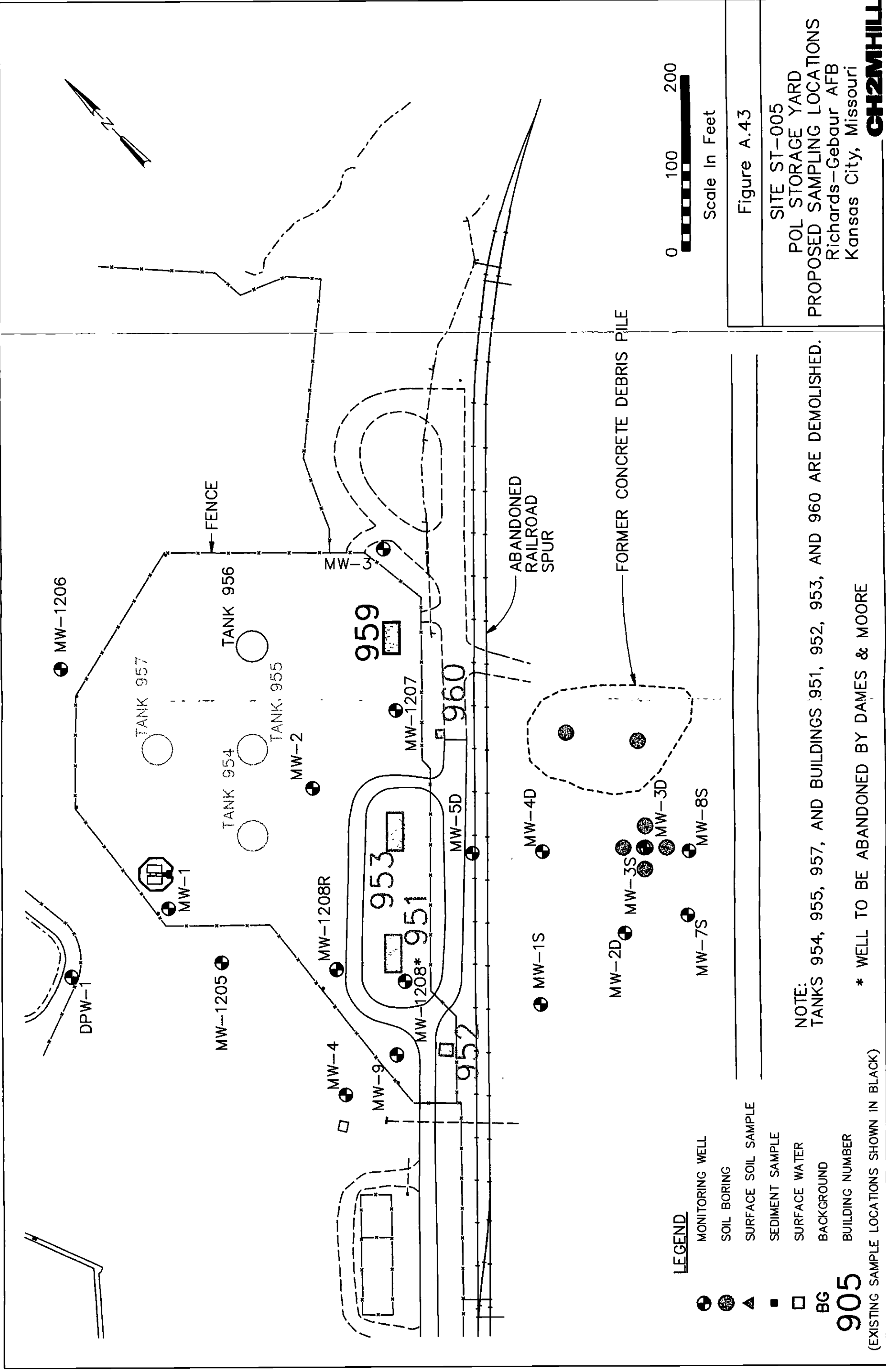
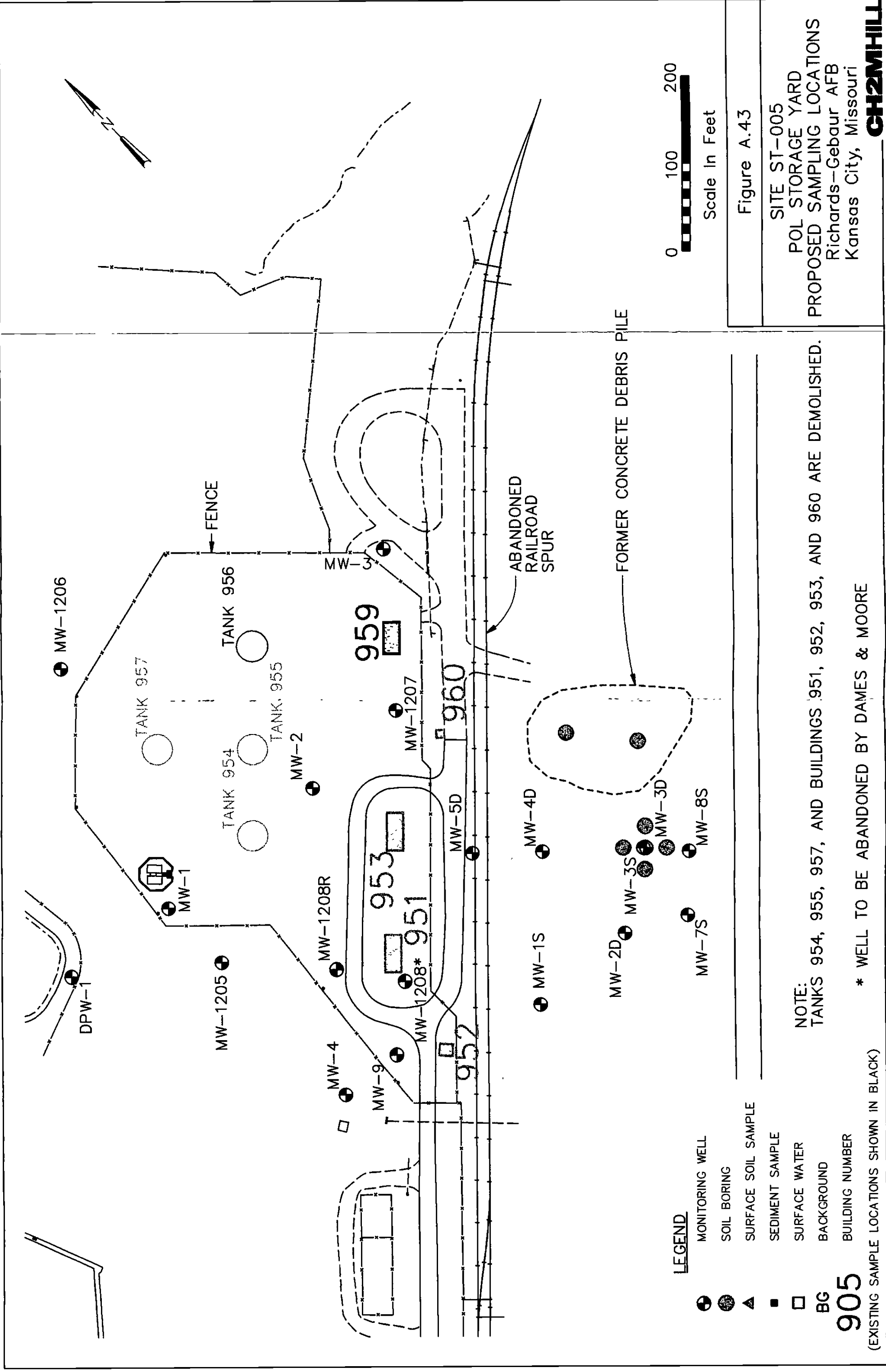
Figure A.42

MONITORING WELL LOCATIONS  
AT POL YARD

Richards-Gebaur AFB  
Kansas City, Missouri

CH2MHILL





## 15.0 SSP – ST 007

### Former UST Area

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#### 15.1 Introduction

This site sampling plan describes the proposed sampling approach at ST 007. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

##### 15.1.1 Site Description

ST 007, the Former UST Area, is located at the former Building 902 site, west of Hangar Road and north of 155<sup>th</sup> Street (**Figure A.44**). Building 902 was used as an aircraft refueling station (USAF, 1991). It was supplied with product from the POL Yard via the fuel hydrant line. Aviation fuel (JP-4) was stored in four 25,000-gallon steel USTs located beneath the building (Jacobs, 1995). The site is approximately 2,600 square feet in area and is covered with a variety of vegetation. The site is adjacent to the airfield runways at one of the highest points on the Base. It is not located in a floodplain.

##### 15.1.2 Summary of Previous Investigations

ST 007 was used as a fuel storage depot from 1954 to 1977. In 1977, the tanks were abandoned in place using water to displace potentially explosive concentrations of organic vapors. No hazardous materials have been stored in the area since 1977. During operation of the system, no leaks were recorded during the fueling system's operational life (USAF, 1991). However, undetected spills or leaks may have occurred at the tanks and associated dispensing lines, resulting in contamination of subsurface soils.

In 1988, Building 902 and the underlying tanks, pumps, and associated piping were demolished and removed. Discolored soils and petroleum odors were noticed during the 1988 excavation and removal of the four USTs (USAF, 1993). Soil samples were collected and analyzed in 1989 to investigate the nature and extent of contamination (General Testing Laboratories, 1989).

A passive venting system was installed as an initial remediation effort (USAF, 1991). Reportedly, eighteen biovents, constructed of 4-inch PVC casing, were placed in the former UST tank pit (Dames & Moore, 1996e). Soil and groundwater samples were collected in 1991 as part of a Site Inspection (Geraghty & Miller, 1991). In 1996, additional soil and groundwater samples were collected to assess the performance of the existing passive bioventing remediation system (Dames & Moore, 1996e).

Sampling locations during previous site investigation are displayed in **Figure A.45**.

##### 15.1.3 Current Site Status

The USTs, pumps and associated piping have been excavated and removed from the site. The remaining bioventing system is scheduled for removal during 1999. Official closure documentation for the four former USTs has not been identified. Therefore, the tanks are not officially recognized as closed.

## 15.2 Chemicals of Concern

Potential COC at the Former UST Area are BTEX, TPH constituents, and PAH compounds. Soil and groundwater sampling has been performed to evaluate the extent and distribution of these chemicals at the site.

### 15.2.1 Soils

In 1989, eight soil borings were drilled and sampled at the site. The soil samples were collected at depths ranging from 3 feet to 12.5 feet below grade. The samples were analyzed for TPH and BTEX constituents (General Testing Laboratories, 1989). TPH constituents were detected above the MDNR UST action level for TPH of 50 ppm, with a maximum detected concentration of 1,618 ppm. Ethylbenzene concentrations of 13.4 and 12.54 ppm were also measured in soil samples, slightly exceeding the MDNR action level of 10 ppm. No other BTEX constituents were detected above their respective State action levels.

Eight more soil samples were collected from eight different soil borings in 1991. The borings were located around the perimeter of the tank removal area. The soil samples were collected from between 4 feet deep and 13.5 feet deep. The samples were analyzed for TPH constituents, VOCs, and metals (Geraghty & Miller, 1991). The analytical results showed that no samples had TPH constituents at concentrations above the State action levels of 50 ppm. VOCs were not detected in any of the samples. Arsenic was detected at 14.9 ppm, slightly above the current CALM STARC level of 11 ppm, in one of the eight samples.

In 1996, an additional series of soil samples were collected from the site over a period of five months (Dames & Moore, 1996e). Thirty-four soil samples from 14 soil borings were collected and analyzed for TPH GRO/DRO, and BTEX constituents. Seven of 34 samples contained TPH concentrations (GRO and DRO) that exceeded the calculated site cleanup level of 500 ppm (see Appendix G). The heavier, less volatile diesel-range hydrocarbons were found to be the dominant species at the site. BTEX constituents did not exceed their previously applicable MDNR ASLs.

### 15.2.2 Groundwater

In 1991, three groundwater monitoring wells were installed at the perimeter of the site and sampled (Geraghty & Miller, 1991). The wells were installed to depths of between 12 feet and 17 feet below ground surface. The groundwater samples were analyzed for TPH compounds, VOCs, and metals. No TPH constituents were detected in the groundwater samples. No VOCs or metals were detected at concentrations that exceeded relevant State water quality criteria, or Federal MCLs.

In 1996, six additional groundwater samples were collected from the three existing monitoring wells (Dames & Moore, 1996e). Three samples were collected during the dry season (March) and three others during the wet season (May). The samples were analyzed for TPH and BTEX constituents. The COC were not detected above State water quality criteria for either sampling episode.

## 15.3 Objectives and Scope

The objectives of the site investigation at ST 007 are as follows:

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient

- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater

To meet these objectives, the following field activities will be conducted at ST 007:

- measure groundwater elevations at three existing wells
- collect groundwater samples from three existing wells
- collect three soil samples from each of eight borings advanced around and within the area excavated in 1988
- analyze soil and groundwater samples for VOCs, SVOCs, and TPH

### **15.3.1 Field Methodologies**

The field and analytical methodologies to be used at ST 007 are summarized below.

#### **15.3.1.1 Monitoring Well Installation**

No monitoring wells will be installed at ST 007 during the Basewide RI/FS.

#### **15.3.1.2 Groundwater Sampling**

Groundwater samples will be collected from each of three existing monitoring wells. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. Samples will be analyzed for VOCs, SVOCs, and TPH.

#### **15.3.1.3 Soil Sampling**

Eight soil borings will be drilled to the top of bedrock. Locations of soil borings are shown in **Figure A.46**. Twenty-four soil samples, three from each soil boring, will be retained for laboratory analyses. The samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. The selected samples will be analyzed for VOCs, SVOCs, and TPH.

#### **15.3.1.4 Surface Water Sampling**

No surface water samples will be collected at ST 007 during the Basewide RI/FS.

#### **15.3.1.5 Sediment Sampling**

No sediment samples will be collected at ST 007 during the Basewide RI/FS.

### **15.3.2 Quality Assurance/Quality Control (QA/QC)**

In accordance with the project QAPP, additional samples will be collected at ST 007 to provide quality control. The following QA/QC samples will be collected at ST 007:

- one duplicate groundwater sample
- three duplicate soil samples

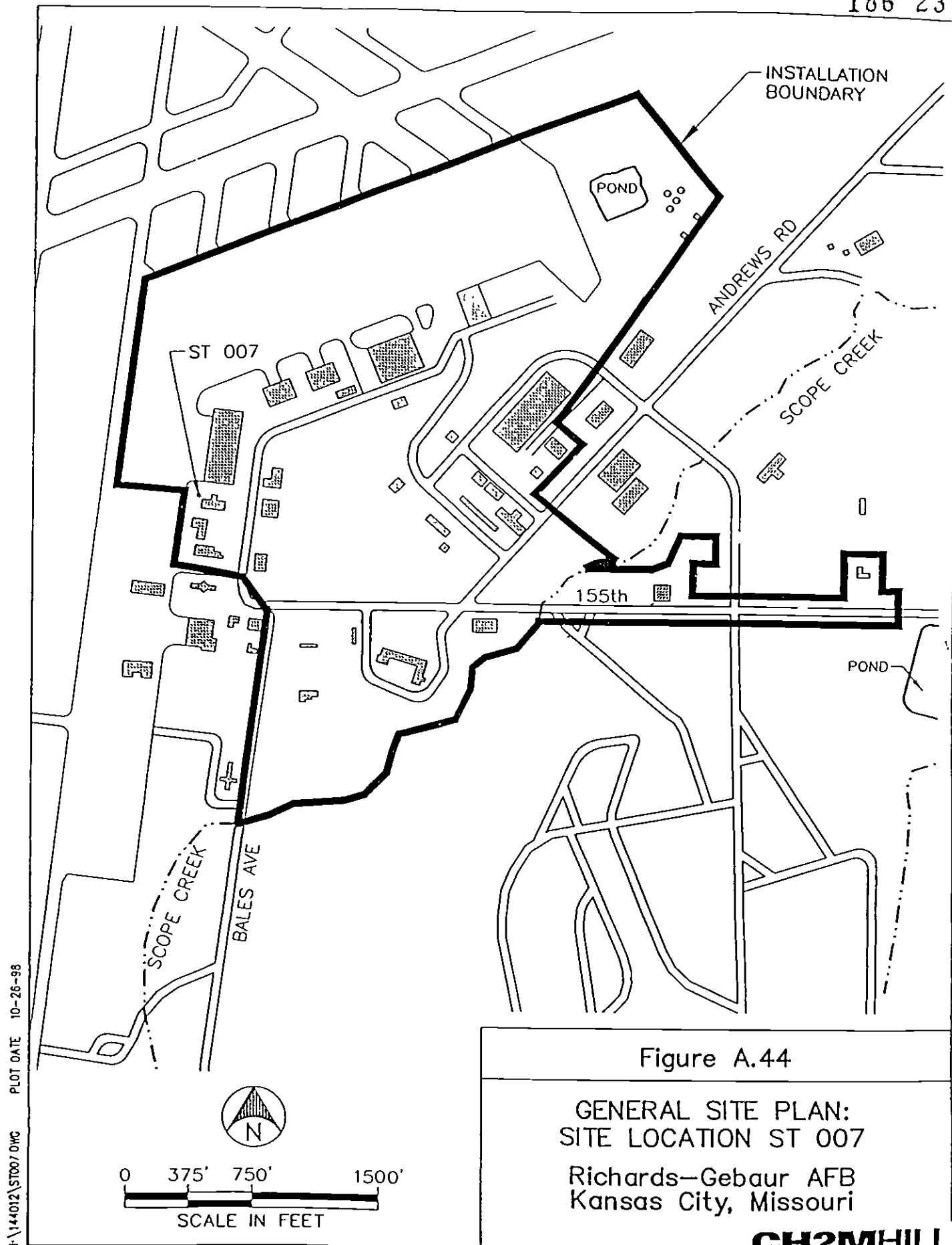
In addition to field duplicates, other QA/QC samples may be collected during the investigation at ST 007. These samples include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

### 15.3.3 Laboratory Analyses

**Table A-15** lists the analytical parameters for soil, groundwater, and associated QC samples.

**Table A-15 Summary of Sample Analyses - ST 007**

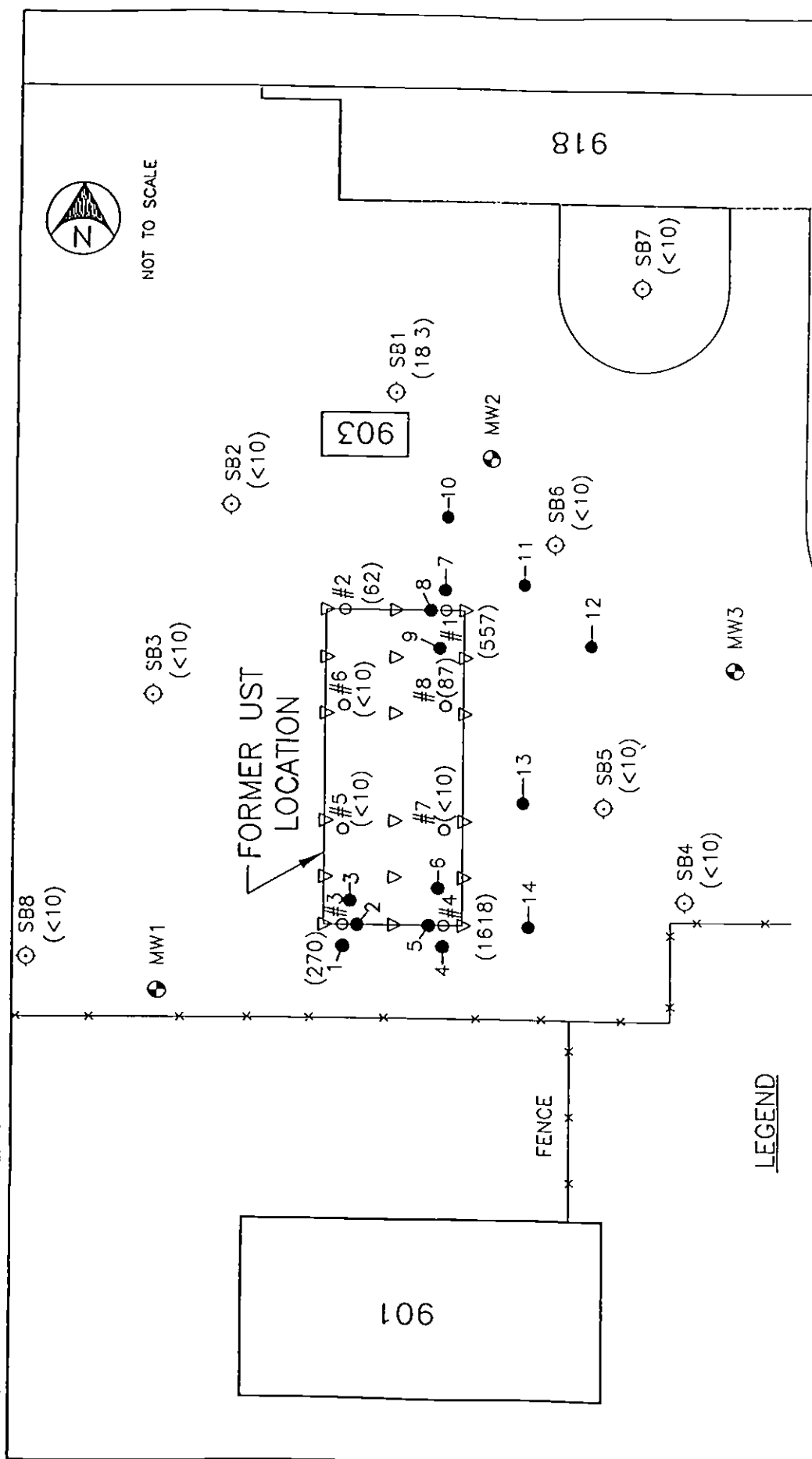
Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater	3	√	√	√		
Soil	24	√	√	√		
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicates <sup>2</sup>	4	√	√	√		
<b>Notes:</b> 1. In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP. 2. At least one field duplicate shall be collected for each sample medium.						



I:\144012\ST007.DWG PLOT DATE 10-26-98

AFTER VERSAR INC, 1996

E:\144012\STD078.0WG PLOT DATE: 10-25-98



LEGEND

- 14 —●— SOIL BORING LOCATION (DAMES & MOORE, 1996)
- MW3 ○= MONITORING WELL (GERAGHTY & MILLER, 1991)
- SB5 ○= SOIL BORING (GERAGHTY & MILLER, 1991)
- #1 ○= SOIL BORING (GENERAL TESTING LABORATORIES, 1989)
- (183) = TPH CONCENTRATION (ppm)
- ▽ = VENTS

Figure A.45

PREVIOUS SAMPLING LOCATIONS  
SITE ST 007

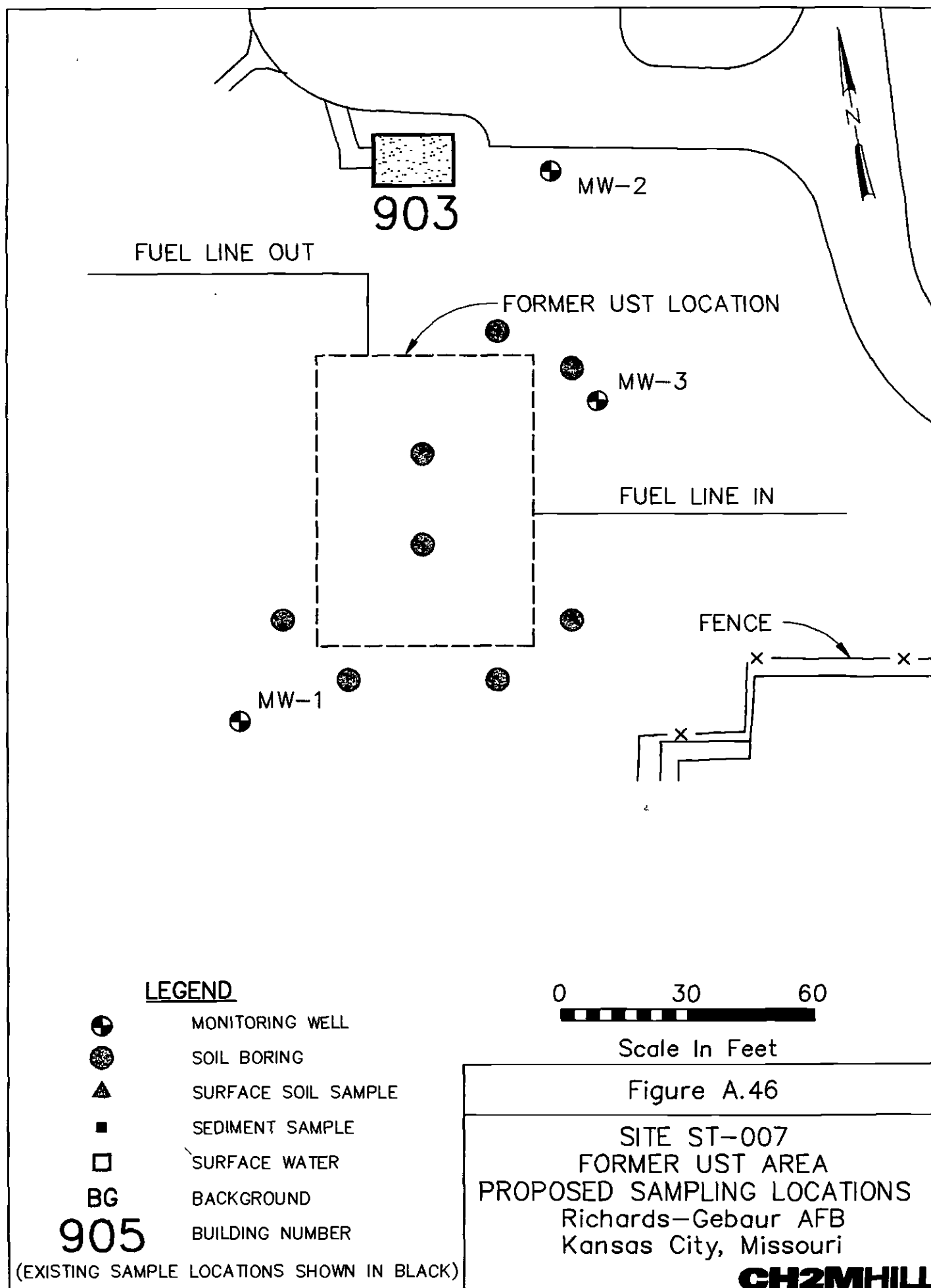
Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

PLOT TIME: 15:37:45

PLOT DATE: 25-OCT-1999

FILENAME: 3673c15d.dlv





## 16.0 SSP – XO 001

### Belton Training Complex (BTC)

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#### 16.1 Introduction

This site sampling plan describes the proposed sampling approach at XO 001. The objective of the sampling effort is to obtain site information needed to fill the data gaps identified in the ECS report (CH2M HILL, 1998).

##### 16.1.1 Site Description

The BTC is located about four miles south of the Base. The site location is shown in Figure A.47. It consists of a former 184-acre drop zone surrounded by a 287-acre safety easement. The site has not been used for over 10 years and is described as a tall grass prairie community with moist savannah wooded area. The site contains grassland, shrubland, forest, marsh, and wetlands (USAF, 1994a).

Two large concrete bunkers are built in the center of the site, and were used in the past for munitions and weapons storage. A generator building, a wooden protection bunker, and a hazardous materials storage shed are located on the north part of the property. All onsite structures are empty and no longer used.

A single gravel road provides access to the site from Prospect Avenue. Burn areas have been identified in the northeast quadrant of the site. These areas were used in the past to dispose of rifle cartridges, flares, and other ordnance by dousing the materials with fuel and igniting and burning. Other site areas were reportedly used for blasting, demolition, and general waste disposal (Versar, 1998).

##### 16.1.2 Summary of Previous Investigations

Parts of the BTC were used as munitions/ordnance storage areas and disposal sites from about 1955 to 1970. The two large concrete storage bunkers were built in 1956 and are approximately 1,250 square feet in size. The other smaller buildings were built over the next 10 years. In 1970, the site was shut down and remained dormant until 1977 when the Air Force began using the property to practice air drops and other military training exercises. Use of the site as a drop zone was discontinued in the mid-1980s. No hazardous materials have been stored in the area since this time (USAF, 1994b).

During its operation, munitions and ordnance were routinely disposed of through burning. The remains of these fires have been noticed during site inspections (Jacobs, 1995; Versar, 1998). The site was initially assessed as part of an Explosive Ordnance Disposal (EOD) Contamination Survey (SAIC, 1994). Subsequently, in 1996 a PA/SI was conducted for the BTC site (Versar, 1998). The 1994 study included a magnetometer survey, a visual site inspection, and field soil screening for explosive chemicals. The 1996 PA/SI identified 41 locations for field screening, including four locations at stream sites. In addition, 11 surface soil samples and five surface water samples were collected.

A geophysical survey was completed at the site in 1997 using seismic refraction and electromagnetic techniques. The purpose of the geophysical survey was to assess the near surface geology and depth to groundwater, and to identify any potential obstructions at proposed soil sampling locations. Also in 1997, 11 direct-push geoprobe soil samples were collected together with three groundwater samples.

### 16.1.3 Current Site Status

The site is not in use. Several spent ordnance areas and abandoned structures are still visible at the site. A PA/SI report has been completed and was submitted to the MDNR in 1998. Though the site has been transferred to the Army Reserve via a Memorandum of Understanding, the Air Force will retain responsibility for completing any necessary remaining environmental work at the site. Should indication of a release or other signs of contamination be found, then additional efforts may be required.

## 16.2 Chemicals of Concern

Because of the site's use as a drop zone and ordnance disposal area, the COC are considered to be those commonly associated with explosives, petroleum products, and metals.

### 16.2.1 Soil

Soil samples were collected and screened during the EOD Contamination Survey (SAIC, 1994). The samples were analyzed for hexahydro-1, 3,5-triazene (RDX) and trinitrotoluene (TNT); TPH-GRO, BTEX, and PAH compounds. The results showed low levels of RDX and TNT (< 6 ppm), and low levels of BTEX (< 35 ppm) and PAH compounds (< 10 ppm).

A total of twenty-two surface and subsurface soil samples were collected from the site during the 1996 PA/SI (Versar, 1998). The samples were analyzed for VOCs, SVOCs, PCBs, pesticides, explosives, DRO and GRO as total reportable petroleum hydrocarbons (TRPH), and metals.

Diesel-range hydrocarbons were detected in eight surface soil samples, ranging in concentration from 16 ppm to 150 ppm below the CALM STARC value of 500 ppm for commercial land use. No VOCs and SVOCs were detected.

Only one of 11 surface soil samples contained lead at a concentration exceeding the CALM STARC level of 660 ppm. The reported concentration was 910 ppm.

Beryllium was detected in all of the soil samples with concentrations ranged from 0.4 ppm to 1.8 ppm, above the corresponding CALM  $C_{IDL}$  value of 0.07 ppm, but well below the CALM  $C_{leach}$  level of 170 ppm. Beryllium was the only metal detected in subsurface soil samples above the CALM STARC of 0.07 ppm. Beryllium concentrations ranged from 0.44 ppm to 1.3 ppm with an average concentration of 0.77 ppm. Because of its ubiquitous presence in regional soils, beryllium is likely to be a natural occurrence in soils at the Belton Training Complex.

### 16.2.2 Groundwater

Four groundwater samples were collected from the site and analyzed for metals, VOCs, SVOCs, pesticides, PCBs, explosives, and TPH during the 1996 PA/SI (Versar, 1998). The groundwater samples and three of the surface water samples were collected from the training and burning area, Disposal Site-1, and Disposal Site-2.

No VOCs, SVOCs, or TPH constituents were detected at concentrations above their applicable EPA MCLs. Pesticides, PCBs, and explosives were not detected in any of the samples.

Barium, lead, mercury, nickel, cadmium, and chromium were found in the groundwater samples with concentrations slightly above their respective MCLs. It is considered likely that these occurrences are the result of natural site conditions, and are unrelated to past site activities. Background concentrations of these metals will be further investigated as part of the proposed investigation.

### 16.2.3 Surface Water

Five surface water samples were collected and analyzed for metals, VOCs, SVOCs, pesticides, PCBs, explosives, and TPH during the 1996 PA/SI (Versar, 1998). Three of the surface water samples were collected from the training and burning area, Disposal Site-1, and Disposal Site-2. Two other surface water samples were collected from streams located northeastern and southeastern part of the BTC.

None of the target organic constituents were detected at concentrations above their applicable EPA MCL or MDNR water quality criteria for protection of freshwater aquatic life. Pesticides, PCBs, and explosives were not detected in any of the samples.

Aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, iron, lead, nickel, and zinc were also detected in surface water samples at concentrations above their respective EPA MCLs or MDNR water quality criteria for protection of freshwater aquatic life. However, the data did not indicate whether the surface water samples were filtered before analysis. The source of these metals could be attributable to the apparently high background concentration of metals in local soil and bedrock.

## 16.3 Objectives and Scope

The objectives of the site investigation at XO 001 are as follows

- evaluate groundwater flow rate, groundwater flow direction, and hydraulic gradient
- identify depth and lithology of uppermost bedrock unit
- identify uppermost water-bearing zone and associated groundwater elevation
- evaluate presence and concentration of COC in onsite soils
- evaluate presence and concentration of COC in groundwater
- assess extent of potential COC in surface water
- assess extent of potential COC in sediment
- establish background concentrations of metals in all media

To meet these objectives, the following field activities will be conducted at XO 001 (note: no field activities will be authorized unless an EOD expert is present onsite):

- install six monitoring wells
- measure groundwater elevations at the six new wells
- collect groundwater samples from the six new wells
- collect soil samples from each of the six monitoring well borings
- collect four background surface soil samples
- collect six surface water samples
- collect six sediment samples
- analyze soil, groundwater, surface water, and sediment samples for TPH and metals

### 16.3.1 Field Methodologies

The field and analytical methodologies to be used at XO 001 are summarized below.

#### 16.3.1.1 Monitoring Well Installation

Six new monitoring wells will be installed at XO 001. The well will be drilled between 6 and 18 inches into the upper bedrock unit. The proposed well locations are shown in **Figure A.48**. As indicated on the figure, two of the six monitoring wells are proposed as background sampling locations. Monitoring well locations may be modified during the Basewide Remedial Investigation, depending on the location of underground utilities. The monitoring wells will be installed and developed according to the procedures described in the FSP.

#### 16.3.1.2 Groundwater Sampling

Groundwater samples will be collected from each of the six new wells. Water level measurements will be made before sampling. Groundwater sampling procedures will follow the methodologies described in the FSP. The samples will be analyzed for TPH and metals.

#### 16.3.1.3 Soil Sampling

Soil samples will be collected during the drilling of monitoring well borings. Each monitoring well boring will be continuously sampled from the surface to completion. Six soil samples, one from each boring, will be retained for laboratory analyses. It is proposed that soil samples collected from the two background monitoring well locations serve as background samples. The samples will be selected based upon the results of field screening, described in the FSP, and at the discretion of the field geologist. The select samples will be analyzed for TPH and metals.

Four surface soil samples will be collected from background areas to assess background concentrations of COC. The sample locations are shown in **Figure A.48**. The samples will be analyzed for TPH and metals.

#### 16.3.1.4 Surface Water Sampling

Six surface water samples will be collected from the site and analyzed for TPH and metals. If surface water is not initially present, an effort will be made to collect samples after it rains. The sample locations are shown in **Figure A.48**. It is proposed that two of the samples serve as background samples. The samples will be collected according to the procedures stated in the FSP. Samples will be analyzed for TPH and metals.

### 16.3.1.5 Sediment Sampling

Six sediment samples will be collected and analyzed for TPH and metals. It is proposed that two of these samples serve as background samples. The sample locations are shown in **Figure A.48**. Samples will be collected according to the procedures specified in this FSP.

### 16.3.2 Quality Assurance/Quality Control (QA/QC)

In accordance with the project QAPP, additional samples will be collected at XO 001 to provide quality control. The following QA/QC samples will be collected during the site investigation at XO 001:

- one duplicate groundwater sample
- one duplicate soil sample
- one duplicate surface water sample
- one duplicate sediment sample

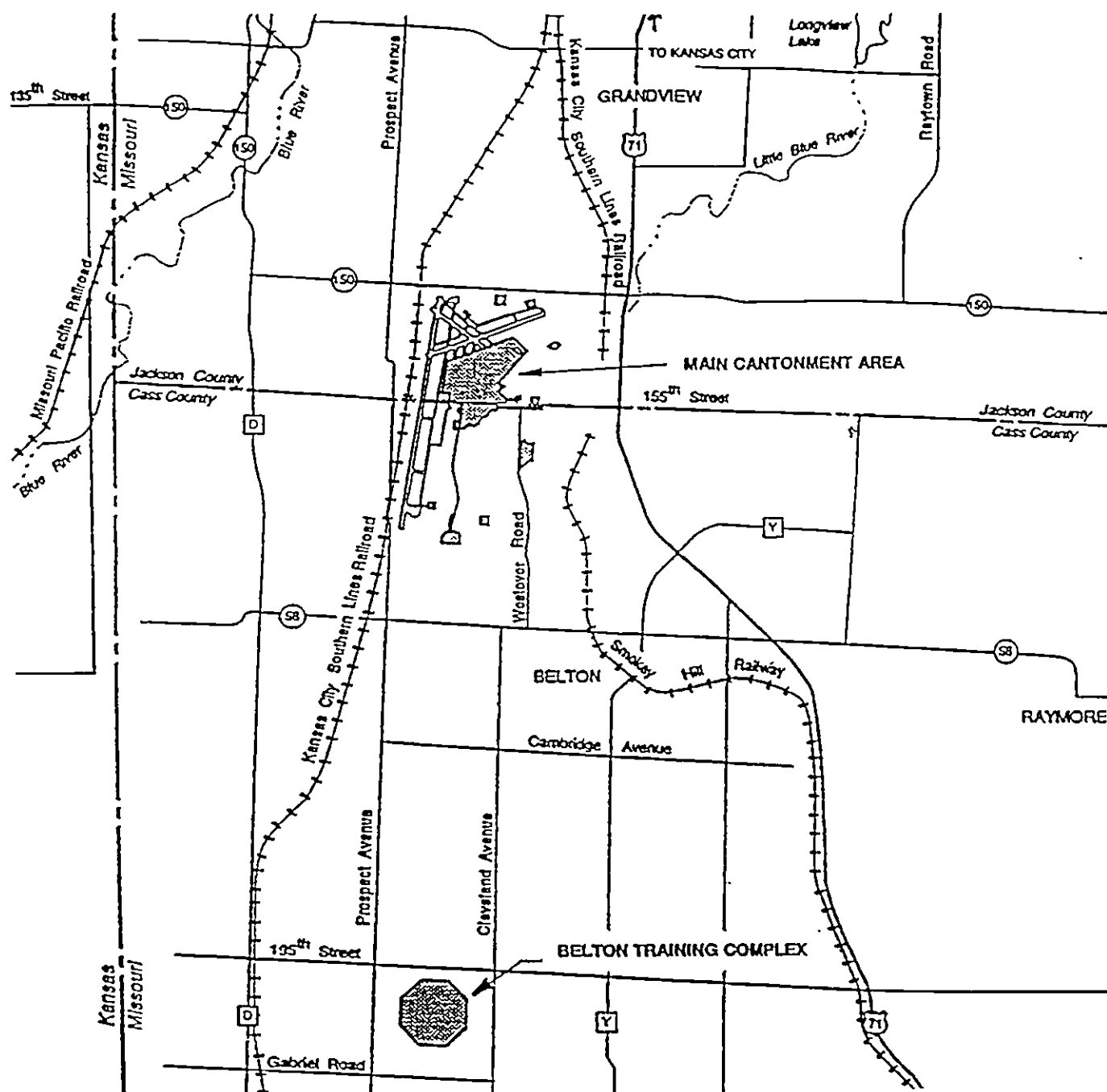
In addition to field duplicates, other QA/QC samples may be collected during the investigation at XO 001. These samples include ambient blanks, equipment blanks, matrix spike/matrix spike duplicates (MS/MSD), and trip blanks.

### 16.3.3 Laboratory Analyses

**Table A-16** lists the analytical parameters for soil, groundwater, surface water, sediment and associated QC samples.

**Table A-16 Summary of Sample Analyses - XO 001**

Sample Type	Sample #	VOCs	SVOCs	TPH	Metals	PCBs
<b>Field Samples</b>						
Groundwater	6			√	√	
Soil	10			√	√	
Sediment	6			√	√	
Surface Water	6			√	√	
<b>QA/QC Samples<sup>1</sup></b>						
Field Duplicates <sup>2</sup>	4			√	√	
Notes						
1 In addition to field duplicates, other QA/QC samples may include ambient blanks, equipment blanks, matrix spike / matrix spike duplicates (MS/MSD), and trip blanks. Descriptions and frequencies of collection for QA/QC samples are described in the FSP						
2 At least one field duplicate shall be collected for each sample medium						



## EXPLANATION





-  Base Property
-  U. S. Highway
-  State Highway
-  County Road



Figure A.47

SITE LOCATION  
SITE X0 001

Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

PLOT DATE 10-26-98

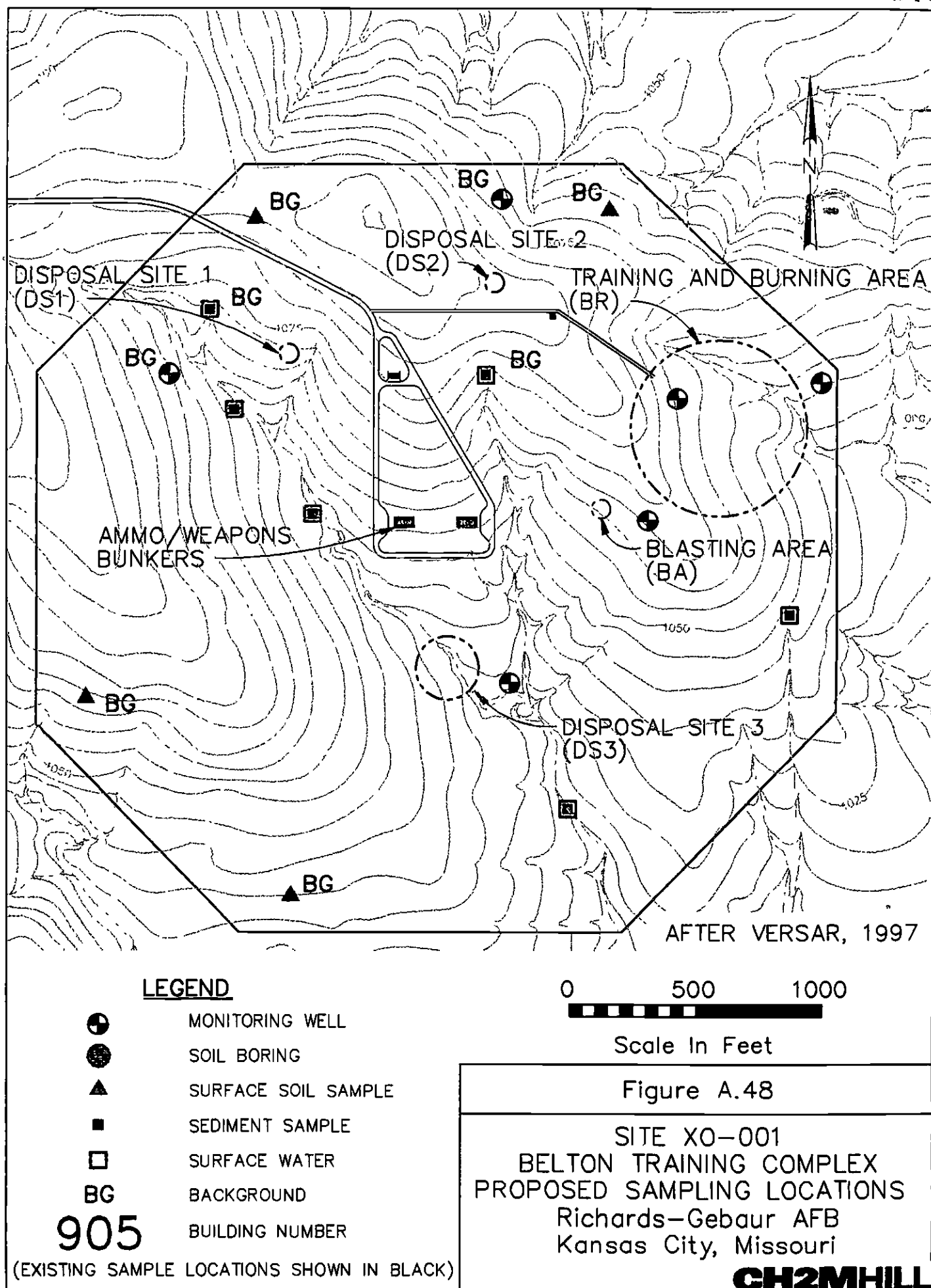
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AFTER DAMES & MOORE, 1995

PLOT TIME: 08:16:38

PLOT DATE: 28-OCT-1999

FILENAME: 3673c16d.dlv



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# TAB

*Appendix B — SOPs*

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# **APPENDIX B**

## **STANDARD OPERATING PROCEDURES**

## STANDARD OPERATING PROCEDURE

# Decontamination of Personnel and Equipment

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## I. Purpose

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

## II. Scope

This is a general description of decontamination procedures.

## III. Equipment and Materials

- Demonstrated analyte-free, deionized ("DI") water (specifically, ASTM Type II water)
- Distilled, organic-free water
- 2.5% (W/W) Alconox<sup>®</sup> and water solution
- Concentrated (V/V) pesticide grade methanol (DO NOT USE ACETONE)
- Large plastic pails or tubs for Alconox<sup>®</sup> and water, scrub brushes, squirt bottles for Alconox<sup>®</sup> solution, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Phthalate-free gloves
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

## IV. Procedures and Guidelines

### A. PERSONNEL DECONTAMINATION

To be performed after completion of tasks whenever potential for contamination exists, and upon leaving the exclusion zone

1. Wash boots in Alconox<sup>®</sup> solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with Alconox<sup>®</sup> solution, remove, and discard into DOT-approved 55-gallon drum.

2. Wash outer gloves in Alconox<sup>®</sup> solution, rinse, remove, and discard into DOT-approved 55-gallon drum.
3. Remove disposable coveralls ("Tyveks") and discard into DOT-approved 55-gallon drum.
4. Remove respirator (if worn).
5. Remove inner gloves and discard.
6. At the end of the work day, shower entire body, including hair, either at the work site or at home.
7. Sanitize respirator if worn.

**B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS**

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Spread plastic on the ground to keep hoses from touching the ground
3. Turn off pump after sampling. Remove pump from well and place pump in decontamination tube, making sure that tubing does not touch the ground
4. Turn pump back on and pump 1 gallon of Alconox<sup>®</sup> solution through the sampling pump.
5. Rinse with 1 gallon of 10% methanol solution pumped through the pump. (DO NOT USE ACETONE).
6. Rinse with 1 gallon of potable water.
7. Rinse with 1 gallon of ASTM Type II Reagent-Grade Water.
8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.
9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

**C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT**

Reusable sampling equipment is decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Before entering the potentially contaminated zone, wrap soil contact points in aluminum foil (shiny side out).
3. Rinse and scrub with potable water.

4. Wash all equipment surfaces that contacted the potentially contaminated soil/water with a potable water/Alconox<sup>®</sup> solution.
5. Rinse with potable water.
6. Rinse with ASTM Type II Reagent-Grade water.
7. If equipment has come in contact with oil or grease, rinse the equipment with pesticide-grade methanol followed by pesticide-grade hexane (DO NOT USE ACETONE).
8. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.
9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

#### D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with Alconox<sup>®</sup> solution, then a towel wet with methanol solution, and finally three times with a towel wet with distilled water. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

#### E. SAMPLE CONTAINER DECONTAMINATION

The outsides of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedure is

1. Wipe container with a paper towel dampened with Alconox<sup>®</sup> solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water
2. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

## V. Attachments

None

## VI. Key Checks and Items

- Clean with solutions of Alconox<sup>®</sup>, methanol, and ASTM Type II Reagent-Grade water.
- Do not use acetone for decontamination.

- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.



## STANDARD OPERATING PROCEDURE

# Logging of Soil Borings

---

## I. Purpose and Scope

This SOP provides guidance to obtain accurate and consistent descriptions of soil characteristics during soil-sampling operations. The characterization is based on visual examination and manual tests, not on laboratory determinations.

## II. Equipment and Materials

- Indelible pens
- Tape measure or ruler
- Field logbook
- Spatula
- HCl, 10 percent solution
- Squirt bottle with water
- Rock- or soil-color chart (e.g., Munsell)
- Grain-size chart
- Hand lens
- Unified Soil Classification System (USCS) index charts and tables to help with soil classification

## III. Procedures and Guidelines

This section covers several aspects of the soil characterization: instructions for field classification of soil, and standard penetration test procedures.

The following information shall be included on each soil boring log.

### A. Heading Information

**Boring/Well Number.** Enter the boring/well number. A numbering system should be chosen that does not conflict with information recorded for previous exploratory work done at the site. Number the sheets consecutively for each boring.

**Location.** If stationing, coordinates, mileposts, or similar project layout information is available, indicate the position of the boring to that system using modifiers such as “approximate” or “estimated” as appropriate.

**Elevation.** Elevation will be determined at the conclusion of field activities.

**Drilling Contractor.** Enter the name of the drilling company and the city and state where the company is based.

**Drilling Method and Equipment.** Identify the bit size and type, drilling fluid (if used), and method of drilling (e.g., rotary, hollow-stem auger). Information on the drilling equipment (e.g., CME 55, Mobile B61) also is noted.

**Water Level and Date.** Enter the depth below ground surface to the apparent water level in the borehole. The information should be recorded as a comment. If free water is not encountered during drilling or cannot be detected because of the drilling method, this information should be noted. Record date and time of day (for tides, river stage) of each water level measurement.

**Date of Start and Finish.** Enter the dates the boring was begun and completed. Time of day should be added if several borings are performed on the same day.

**Logger.** Enter the first initial and full last name.

## **B. Technical Data**

**Depth Below Surface.** Use a depth scale that is appropriate for the sample spacing and for the complexity of subsurface conditions.

**Sample Interval.** Note the depth at the top and bottom of the sample interval.

**Sample Type and Number.** Enter the sample type and number. SS-1 = split spoon, first sample. Number samples consecutively regardless of type. Enter a sample number even if no material was recovered in the sampler.

**Sample Recovery.** Enter the length to the nearest 0.1 foot of soil sample recovered from the sampler. Often, there will be some wash or caved material above the sample; do not include the wash material in the measurement. Record recovery in feet.

**Standard Penetration Test Results.** In this column, enter the number of blows required for each 6 inches of sampler penetration and the "N" value, which is the sum of the blows required to drive the sampler the second and third 6-inch intervals. A typical standard penetration test involving successive blow counts of 2, 3 and 4 is recorded as 2-3-4 and (7). The standard penetration test is terminated if the sampler encounters refusal. Refusal is a penetration of less than 6 inches with a blow count of 50. A partial penetration of 50 blows for 4 inches is recorded as 50/4 inches. Penetration by the weight of the slide hammer only is recorded as "WOH."

Samples should be collected using a 140-pound hammer and 2-inch diameter split spoons.

Sample also may be collected using a 300-pound hammer or 3-inch-diameter split-spoon samples at the site. However, use of either of these sample collection devices invalidates standard penetration test results and should be noted in the comments section of the log. The 300-pound hammer should only be used for collection of 3-inch-diameter split-spoon samples. Blow counts should be recorded for collection of samples using either a 3-inch split-spoon, or a 300-pound hammer. An "N" value need not be calculated.

**Soil Description.** The soil classification should follow the format described in the "Field Classification of Soil" subsection below.

**Comments.** Include all pertinent observations (changes in drilling fluid color, rod drops, drilling chatter, rod bounce as in driving on a cobble, damaged Shelby tubes, and equipment malfunctions). In addition, note if casing was used, the sizes and depths installed, and if drilling fluid was added or changed. You should instruct

the driller to alert you to any significant changes in drilling (changes in material, occurrence of boulders, and loss of drilling fluid). Such information should be attributed to the driller and recorded in this column.

Specific information might include the following:

- The date and the time drilling began and ended each day
- The depth and size of casing and the method of installation
- The date, time, and depth of water level measurements
- Depth of rod chatter
- Depth and percentage of drilling fluid loss
- Depth of hole caving or heaving
- Depth of change in material
- Health and safety monitoring data
- Drilling interval through a boulder

### **C. Field Classification of Soil**

This section presents the format for the field classification of soil. In general, the approach and format for classifying soils should conform to ASTM D 2488, Visual-Manual Procedure for Description and Identification of Soils (attached).

The Unified Soil Classification System is based on numerical values of certain soil properties that are measured by laboratory tests (ASTM D 2487). It is possible, however, to estimate these values in the field with reasonable accuracy using visual-manual procedures (ASTM D 2488). In addition, some elements of a complete soil description, such as the presence of cobbles or boulders, changes in strata, and the relative proportions of soil types in a bedded deposit, can be obtained only in the field.

Soil descriptions should be precise and comprehensive without being verbose. The correct overall impression of the soil should not be distorted by excessive emphasis on insignificant details. In general, similarities rather than differences between consecutive samples should be stressed.

Soil descriptions must be recorded for every soil sample collected. The format and order for soil descriptions should be as follows:

1. Soil name (synonymous with ASTM D 2488-90 Group Name) with appropriate modifiers. Soil name should be in all capitals in the log, for example "POORLY-GRADED SAND."
2. Group symbol, in parentheses, for example, "(SP) "
3. Color, using Munsell color designation
4. Moisture content
5. Relative density or consistency
6. Soil structure, mineralogy, or other descriptors

This order follows, in general, the format described in ASTM D 2488-90

### **D. Soil Name**

The basic name of a soil should be the ASTM D 2488 Group Name on the basis of visual estimates of gradation and plasticity. The soil name should be capitalized.

Examples of acceptable soil names are illustrated by the following descriptions:

- A soil sample is visually estimated to contain 15 percent gravel, 55 percent sand, and 30 percent fines (passing No. 200 sieve). The fines are estimated as either low or highly plastic silt. This visual classification is SILTY SAND WITH GRAVEL, with a Group Symbol of (SM).
- Another soil sample has the following visual estimate: 10 percent gravel, 30 percent sand, and 60 percent fines (passing the No. 200 sieve). The fines are estimated as low plastic silt. This visual classification is SANDY SILT. The gravel portion is not included in the soil name because the gravel portion was estimated as less than 15 percent. The Group Symbol is (ML).

The gradation of coarse-grained soil (more than 50 percent retained on No. 200 sieve) is included in the specific soil name in accordance with ASTM D 2488-90. There is no need to further document the gradation. However, the maximum size and angularity or roundness of gravel and sand-sized particles should be recorded. For fine-grained soil (50 percent or more passing the No. 200 sieve), the name is modified by the appropriate plasticity/elasticity term in accordance with ASTM D 2488-90.

Interlayered soil should each be described starting with the predominant type. An introductory name, such as "Interlayered Sand and Silt," should be used. In addition, the relative proportion of each soil type should be indicated.

Where helpful, the evaluation of plasticity/elasticity can be justified by describing results from any of the visual-manual procedures for identifying fine-grained soils, such as reaction to shaking, toughness of a soil thread, or dry strength as described in ASTM D 2488-90.

#### **E. Group Symbol**

The appropriate group symbol from ASTM D 2488-90 must be given after each soil name. The group symbol should be placed in parentheses to indicate that the classification has been estimated.

In accordance with ASTM D 2488-90, dual symbols (e.g., GP-GM or SW-SC) can be used to indicate that a soil is estimated to have about 10 percent fines. Borderline symbols (e.g., GM/SM or SW/SP) can be used to indicate that a soil sample has been identified as having properties that do not distinctly place the soil into a specific group. Generally, the group name assigned to a soil with a borderline symbol should be the group name for the first symbol. The use of a borderline symbol should not be used indiscriminately. Every effort should be made to first place the soil into a single group.

#### **F. Color**

The color of a soil must be given. The color description should be based on the Munsell system. The color name and the hue, value, and chroma should be given.

#### **G. Moisture Content**

The degree of moisture present in a soil sample should be defined as dry, moist, or wet. Moisture content can be estimated from the criteria listed on Table 1.

**Table 1**  
**Criteria for Describing Moisture Content**

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below water table

#### **H. Relative Density or Consistency**

Relative density of a coarse-grained (cohesionless) soil is based on N-values (ASTM D 1586). If the presence of large gravel, disturbance of the sample, or non-standard sample collection makes determination of the in situ relative density or consistency difficult, then this item should be left out of the description and explained in the Comments column of the soil boring log.

Consistency of fine-grained (cohesive) soil is properly based on results of pocket penetrometer or torvane results. In the absence of this information, consistency can be estimated from N-values..

#### **I. Soil Structure, Mineralogy, and Other Descriptors**

Discontinuities and inclusions are important and should be described. Such features include joints or fissures, slickensides, bedding or laminations, veins, root holes, and wood debris.

Significant mineralogical information such as cementation, abundant mica, or unusual mineralogy should be described.

Other descriptors may include particle size range or percentages, particle angularity or shape, maximum particle size, hardness of large particles, plasticity of fines, dry strength, dilatancy, toughness, reaction to HCl, and staining, as well as other information such as organic debris, odor, or presence of free product.

## **IV. Attachments**

ASTM D 2488-90: Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)

## **V. Key Checks and Preventive Maintenance**

Check entries to the soil-boring log and field logbook in the field; because the samples will be disposed of at the end of fieldwork, confirmation and corrections cannot be made later. Check that sample numbers and intervals are properly specified. Check that drilling and sampling equipment is decontaminated using the procedures defined in SOP *Decontamination of Drilling Rigs and Equipment*.

## STANDARD OPERATING PROCEDURE

# Soil Boring Drilling and Abandonment

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## I. Purpose and Scope

The purpose of this guideline is to describe methods to obtain samples of subsurface soil using hollow-stem auger, and then backfill boreholes to the surface. The guideline covers both split-spoon sampling and thin-walled tube sampling and includes soil borings through surface casings installed to prevent potential contamination in shallow water-bearing units from migrating downward into deeper units.

## II. Equipment and Materials

- Truck-mounted drilling rig, skid rig, or barge-mounted tripod rig
- Hollow-stem augers and associated equipment or either rotary-drilling or sonic-drilling equipment
- Steel or Schedule 80 PVC casing, at least 6.25-inch inside diameter (if surface casing is required)
- Split-spoon or thin-walled tube samplers
- Downhole compacting tool (e.g., a pipe with a flat plate attached to the bottom)
- Cement
- Bentonite

## III. Procedures and Guidelines

### A. Drilling

Construction standards for boreholes will comply with Missouri Well Construction Rules, 10 CSR 23-1.010 through 6.060.

Continuous-flight hollow-stem augers (HSA) with an inside diameter of at least 3.25 inches are used. The use of water or other fluid to assist in hollow-stem drilling will be avoided. Rotary drilling will be with a similar minimum diameter.

The bit of the auger or drill is placed on the ground at the location to be drilled and then turned with the drilling or soil-coring rig. The drilling is advanced to a depth just above the top of the interval to be sampled. For sonic drilling, a continuous core is collected and the sample interval is selected from the length of core run.

While advancing the auger or drill to the full borehole depth, the soils removed from the boring will be screened using a portable volatile organics detector.

Surface casing may be installed where soil borings will penetrate a confining layer. The surface casing will be installed to prevent potential contamination in shallow water-bearing units from migrating downward into deeper units.

If the split-spoon sampling is to be advanced with a 3.25-inch ID, 8.25-inch outside

diameter (O.D.) HSA, the surface casing will require a minimum 10.25-inch surface casing. The casing would be installed using a 14.25-inch I.D. HSA. Alternatively, the split-spoon sampling may be advanced with mud-rotary drilling, which would require a only a 6.25-inch I.D. surface casing and a 10.25-inch I.D. HSA.

The surface casing will be seated at least 5 feet into an underlying clay or silt layer and will be sealed in place using a bentonite slurry or bentonite pellets. This seal will prevent movement of groundwater downward from the shallow water-bearing unit but will allow the casing to be removed easily when the split-spoon sampling is completed.

#### B. Abandonment

Boreholes will be abandoned in accordance with the requirements set forth in 10 CSR 6.050.

The borehole will be grouted from total depth to within two feet of ground surface with bentonite-cement grout. The cement-bentonite grout will be installed continuously in one operation from the bottom of the space to be grouted to the ground surface. When installing grout in soil borings, the grout will be installed through a tremie pipe that is placed inside the augers or to the bottom of the borehole. Procedures and materials for grouting boreholes are described in 10 CSR 23-3.030 (3) and (4). The grouting will be completed before the augers or any temporary casing or drilling mud are removed.

A registration report must be submitted to the Missouri Department of Natural Resources Division of Geology and Land Survey. The report shall document the method used to plug the borehole.

#### C. Decontamination and Waste Disposal

Before sampling begins, equipment will be decontaminated according to the procedures identified in SOP *Decontamination of Drilling Rig and Equipment*. The location to be sampled is cleared of debris and trash, and the location is noted in the logbook.

The soil cuttings are to be drummed and managed as described in SOP *Disposal of Waste Fluids and Soils* and the investigation-derived waste management plan.

## IV. Attachments

ASTM D 1586

ASTM D 1587

## V. Key Checks and Preventative Maintenance

Check that the drilling rig or soil-coring rig is in working order. Check that the borehole is grouted to the ground surface at the completion of drilling and sampling.

## STANDARD OPERATING PROCEDURE

# Monitoring Well Installation and Development

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## I. Purpose

To provide site personnel with a review of the well installation procedures that will be performed. These procedures are to be considered general guidelines only and are in no way intended to supplement or replace the contractual specifications in the driller's subcontract.

## II. Scope

Monitoring well installations that are planned for shallow and/or deep unconsolidated aquifers.

## III. Equipment and Materials

1. Drilling rig (hollow stem auger, sonic, or mud rotary)
2. Well-construction materials (i.e., surface casing, screens, riser, casing, caps, bottom plugs, sand, bentonite, grout, and surface-finish materials)
3. Development equipment

## IV. Procedures and Guidelines

1. Wells will be installed in accordance with the requirements of the Missouri Well Construction Rules, 10 CSR 23-1.010 through 6.060
2. The threaded connections will be water-tight.
3. Well screens generally will be constructed of 10-slot or 20-slot Schedule 40 PVC and will at least 10 feet in length. The exact slot size and length will be determined by the field team supervisor.
4. A record of the finished well construction will be compiled
5. All soils and liquids generated during well installations will be drummed for proper disposal.

### Monitoring Well Installation

1. Monitoring wells in unconsolidated materials will be installed in at least 6-inch-diameter boreholes to accommodate well completion materials in designated locations.



2. Monitoring wells in unconsolidated materials will be constructed of 2-inch-diameter, factory manufactured, flush-jointed, Schedule 40 PVC screen with threaded bottom plug and riser.
3. Screens will be filter packed with a proper-sized and graded, thoroughly washed, sound, durable, well-rounded basalt or siliceous sand. When using hollow-stem augers, the filter pack will be installed by slowly pouring the sand into the annular space while simultaneously raising the augers and using a weighted tape to sound for the sand surface. For rotary-drilled wells, the height of the sand pack also will be sounded with a weighted tape.
4. The filter pack shall consist of silica sand or gravel and shall extend from the bottom of the hole to at least two feet above the top of the well screen. The top of the sand pack shall be sounded to verify its depth during placement. Additional filter pack shall be placed as required to return the level of the pack to two feet above the screen.
5. Annular well seals will consist of at least 3 feet of pelletized or granular bentonite clay placed above the filter pack. If necessary the pellets will be hydrated using potable water. For wells installed using hollow-stem augers, the bentonite will be poured into the annular space while slowly raising the augers and sounding for the top of the bentonite with a weighted tape. A side-discharging tremie pipe will be used to install the bentonite seal material, which shall consist of 100 percent sodium bentonite. Alternative sealing methods may be used for wells that are less than 15 feet in depth. The alternative methods must be approved, in writing by AFCEE, before field work begins.
6. The top of the annular seal will be measured after the bentonite seal has been allowed to hydrate and before the grout is applied.
7. The casing grout requirements are the following: (1) the casing grout shall extend from the top of the bentonite seal to ground surface, (2) the grout shall be mixed in the following proportions: 94 pounds of neat Type I Portland or American Petroleum Institute Class A cement, not more than 4 pounds of 100 percent sodium bentonite powder, and not more than 8 gallons of potable water, (3) all grout shall be pump-tremied using a side-discharge tremie pipe, and pumping shall continue until 20 percent of the grout has been returned to the surface, and (4) in wells where the bentonite seal is visible and within 30 feet of the land surface, the 20 percent return is not necessary so long as the tremie pipe is pulled back as the grout is emplaced.
8. For flush-mounted completions, cut the casing about three inches below the land surface and provide a water-tight casing cap to prevent surface water from entering the well. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole shall be placed in the upper portion of the casing, or a ventilated well cap shall be used. A freely draining valve box with a locking cover shall be placed over the casing. The top of the casing shall be at least one foot above the bottom of the box. The valve box lid shall be centered in a three-foot diameter, four-inch thick concrete pad that slopes away from the box at 1/4 inch per foot. The identity of the well shall be permanently marked on the valve box lid and the casing cap. Where heavy traffic may pass over the well or for other reasons, the concrete pad and valve box/lid assembly shall be constructed to meet the strength requirements of surrounding surfaces.

- 9 When above-ground surface completion is used, extend the well casing two or three feet above land surface. Provide a casing cap for each well, and shield the extended casing with a steel sleeve that is placed over the casing and cap and seated in a 3-foot by 3-foot by 4-inch concrete surface pad. To allow for escape of gas, a small diameter (e.g., 1/4-inch) vent hole shall be placed in the well casing, or a ventilated well cap shall be used. The concrete surface pad shall be reinforced with steel reinforcing bars at least 1/4 inch in diameter. The ground surface shall be freed of grass and scoured to a depth of two inches before setting the concrete pad. The diameter of the sleeve shall be at least six inches greater than the diameter of the casing. Slope the pad away from the well sleeve. Install a lockable cap or lid on the guard pipe. The identity of the well shall be permanently marked on the casing cap and the protective sleeve. Install three 3-inch diameter concrete-filled steel guard posts. The guard posts shall be five feet in total length and installed radially from each well head. Recess the guard posts approximately two feet into the ground and set in concrete. Do not install the guard posts in the concrete pad placed at the well base. The protective sleeve and guard posts shall be painted with a color specified by the installation civil engineer. In areas of extreme frost heaving, the concrete pads specified may not be appropriate, and alternate designs maybe required. Special consideration and approvals may be needed in these areas.
10. The contractor may propose alternate surface completion methods to address various soil conditions specific to the site. Prior approval for any alternate method shall be obtained, in writing, from AFCEE before well construction begins.
11. All wells shall be secured as soon as possible after drilling. Provide corrosion-resistant locks for both flush and above-ground surface completions. The locks must either have identical keys or be keyed for opening with one master key. Deliver the lock keys to the appropriate Air Force personnel following completion of the field effort.

### **Well Development**

- 1 New monitoring wells will be developed after the well has been completely installed and the grout has hardened (at least 24 hours).
- 2 Drilling fluids used for well construction will be removed during well development.
- 3 The well will be developed using surge blocks and bailers or pumps. Alternative methods shall be used only after receiving AFCEE approval in writing.
4. Equipment placed in the well will be decontaminated before use.
- 5 If information is available, begin developing in the least-contaminated well first.
- 6 Development will include surging the well by abruptly stopping flow and allowing water in the well column to fall back into the well.
7. Pipes and pumps must not be fitted with foot valves or other devices that might inhibit the return flow of water to the well.
- 8 Surging should continue throughout the development process.
9. Well development will continue until: (a) the suspended sediment content of the

water is less than 0.75 mL/L, as measured in an Imhoff cone according to method E160.5; (b) the turbidity remains within a 10 nephelometric turbidity unit range for at least 30 minutes; and (c) the stabilization criteria are met.

10. Development water will be considered hazardous and placed in sealed 55-gallon U.S. DOT approved steel drums. CH2M HILL will label and date the drums, and transport the drums to a designated site for temporary storage.

## **V. Attachments**

None.

## **VI. Key Check and Items**

Ensure that all equipment is properly decontaminated as needed. Care shall be taken when making downhole measurements to ensure that proper heights of sand, seal, and grout are achieved.

## STANDARD OPERATING PROCEDURE

# Abandonment of Monitoring Wells

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## I. Purpose

To provide a general guideline for the abandonment of groundwater monitoring wells, per the requirements of the Missouri Water Well Drillers Act, specifically 10 CSR 23-4.080.

## II. Scope

The general protocols for abandoning monitoring wells are outlined.

## III. Equipment and Materials

1. Drilling rig
2. Well-abandonment materials (i.e., sand, bentonite, cement, and surface-finish materials)

## IV. Procedures and Guidelines

1. All pumps, sampling equipment, debris, or other substances that would interfere with the proper plugging of the well must be removed.
2. All protective casing, riser pipe and well screen must be removed from the borehole, if possible, unless approved by the Missouri Department of Natural Resources (MDNR) Division of Geology and Land Survey (Division). Because the primary purpose of well plugging is to eliminate vertical fluid migration along the borehole, the preferred method of plugging involves casing and riser pipe removal. If, when removing the casing the borehole begins to collapse, grout must be simultaneously emplaced while the casing is removed to ensure a proper seal. In certain situations, the casing or riser pipe must be drilled out if it can not be removed before the well is plugged. These situations will be determined on a case-by-case basis by the Division. When casing is not required to be removed or if after attempting to remove the casing, it is not possible to remove it, then a hole must be dug around the casing three feet deep and the casing and riser pipe cut off at that depth.
3. The well must be filled from bottom to top with grout. 10 CSR 23-4.060 (11) sets standards for grout types that may be used when plugging monitoring wells.
4. If bentonite grout is used, after the grout is fully cured, check for settlement and top off if necessary. Fill with soil and compact the upper two feet of hole or pave. The purpose of the compacted soil is to ensure that dehydration of the bentonite grout does not occur over time. If cement-slurry grout is used, fill the upper two

feet with soil or pave. Slight mounding over the well is recommended to prevent water from standing in the immediate area of the well.

5. The plugging or complete excavation of all monitoring wells must be reported on a registration report form supplied by the Division. These forms must be submitted, along with the fee, within sixty (60) days of the plugging (see 10 CSR 23-3 for applicable fees). If the review of the registration report form shows that the well has been plugged according to the rules, a registration number will be issued and sent to the well owner. The registration number indicates that the well was plugged according to the standards set out in the rules. When field screening type of temporary wells are drilled, usually multiple installations per monitoring site are used. All temporary wells per monitoring site may be reported on one (1) registration report form if they are all plugged the same way and only one registration fee is required per site.
6. Material used to plug monitoring wells must be compatible with any contaminants in the well so that the plugging action of the grout is not destroyed by any chemical reactions that may take place in the borehole environment.
7. Monitoring wells less than ten feet (10') in depth must be plugged by returning uncontaminated native material or grout into the hole it was taken from. No reporting is required for these wells.

## **V. Attachments**

None.

## **VI. Key Check and Items**

Ensure that all equipment is properly decontaminated as needed. Only new, sealed materials (e.g., screens, risers, and sand) will be used in constructing the well. Care shall be taken when making downhole measurements to ensure that proper heights of sand, seal, and grout are achieved.

## STANDARD OPERATING PROCEDURE

# Decontamination of Drilling Rigs and Equipment

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## I. Purpose and Scope

The purpose of this guideline is to provide methods for the decontamination of drilling rigs, downhole drilling tools, and water-level measurement equipment. Personnel decontamination procedures are not addressed in this SOP; refer to the Health and Safety Plan (HSP) and SOP *Decontamination of Personnel and Equipment*. Sample bottles will not be field decontaminated; instead they will be purchased with certification of laboratory sterilization.

## II. Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Alconox® or Liquinox®
- Buckets
- Brushes
- Distilled organic-free water
- Methanol, pesticide grade
- Hexane, pesticide grade
- ASTM–Type II Reagent-Grade Water
- Aluminum foil

## III. Procedures and Guidelines

### A. Drilling Rigs and Monitoring Well Materials

Before the onset of drilling, after each borehole, before drilling through permanent isolation casing, and before leaving the site, heavy equipment and machinery will be decontaminated using an Alconox® solution and high-pressure hot water at a designated area. The equipment shall then be rinsed with potable water. The steam cleaning area will be designed to contain decontamination wastes and waste waters and can be an HDPE-lined, bermed pad. A pumping system will be used to convey decontaminated water from the pad to drums.

Surface casings may be steam cleaned in the field if they are exposed to contamination at the site prior to use.

### B. Downhole Drilling Tools

At the following times, downhole tools will be decontaminated as described

above: 1) before the onset of drilling; 2) prior to drilling through permanent isolation casing; and 3) between boreholes. This will include, but is not limited to, rods, split-spoons or similar samplers, coring equipment, augers, and casing.

Before the use of a sampling device such as a split-spoon sampler for the collection of a soil sample for physical characterization or chemical analysis, the sampler shall be cleaned by scrubbing with a potable water / Alconox® solution, rinsing with potable water, and then rinsing with ASTM Type II Reagent-Grade Water. If equipment has come in contact with oil or grease, rinse the equipment with pesticide-grade methanol followed by pesticide-grade hexane.

#### C. Field Analytical Equipment

##### 1. Water Level Indicators

Water level indicators that consist of a probe that comes into contact with the groundwater must be decontaminated using the following steps:

- a. Rinse with tap water
- b. Rinse with de-ionized water
- c. Solvent rinse with methanol
- d. Rinse with ASTM Type II Reagent-Grade Water

##### 2 Probes

Probes, for example, pH or specific ion electrodes, geophysical probes, or thermometers that would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise. For probes that make no direct contact, for example, OVM equipment, the probe will be wiped with clean paper-towels or cloth wetted with methanol.

## IV. Attachments

None.

## V. Key Checks and Preventative Maintenance

The effectiveness of field cleaning procedures will be monitored by rinsing decontaminated equipment with organic-free water and submitting the rinse water in standard sample containers for analysis. Anytime a sampling event occurs, at least one such quality control sample shall be collected. At least one piece of field equipment shall be selected for this procedure each time equipment is washed. An attempt should be made to select different pieces of equipment for this procedure.

## STANDARD OPERATING PROCEDURE

# Disposal of Waste Fluids and Solids

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## I. Purpose and Scope

This SOP describes the procedures used to dispose of hazardous fluid and solid materials, or investigation-derived waste (IDW), generated as a result of the site operations. This SOP does not provide guidance on the details of Department of Transportation regulations pertaining to the transport of hazardous wastes; the appropriate Code of Federal Regulations (49 CFR 171 through 177) should be referenced. Also, the site investigation-derived waste management plan should be consulted for additional information and should take precedence over this SOP.

## II. Equipment and Materials

### A. Fluids

- DOT-approved 55-gallon steel drums or Baker® Tanks
- Tools for securing drum lids
- Funnel for transferring liquid into drum
- Labels
- Marking pen for appropriate labels
- Seals for 55-gallon steel drums

### B. Solids

- DOT-approved 55-gallon steel drums or rollofs
- Tools for securing drum lids
- Plastic sheets
- Labels
- Marking pen for appropriate labels

## III. Procedures and Guidelines

### A. Methodology

Clean, empty drums or rollofs or Baker® Tanks will be brought to the site by the drilling subcontractor for soil and groundwater collection and storage. The empty drums will be located at the field staging area and moved to drilling locations as required. The drums will be filled with the drilling and well installation wastes, capped, sealed, and moved to the onsite drum storage area by the drilling subcontractor. The full drums will separate types of wastes by media. The drums will be labeled as they are filled in the field and labels indicating that the contents are potentially hazardous affixed.

The drum contents will be sampled to determine the disposal requirements of the



IDW. The drum sampling will be accomplished through the collection and submittal of composite samples, one sample per 10 drums containing the same media. Similar compositing will be performed in each rolloff to obtain a representative sample. The compositing of the sample will be accomplished by collecting a specific volume of the material in each drum into a large sample container. When samples from each of the drums being sampled in a single compositing are collected, the sample will be submitted for TCLP, ignitability, corrosivity, and reactivity analysis. The analysis will be used to determine if drilling wastes are covered by land disposal restrictions.

If rolloffs are used, compositing and sampling of soil will comply with applicable state and federal regulations.

#### B. Labels

Drums and other containers used for storing wastes from drilling operations will be labeled when accumulation in the container begins. Labels will include the following minimum information:

- Container number
- Container contents
- Origin (source area including individuals wells, piezometers, and soil borings)
- Constituents of concern
- Date that accumulation began
- Date that accumulation ended
- When laboratory results are received, drum labels will be completed or revised to indicate the hazardous waste constituents in compliance with Title 40 of the Code of Federal Regulations, Part 262, Subpart C.

#### C. Fluids

Drilling fluids generated during soil boring and groundwater discharged during development and purging of the monitoring wells will be collected in 55-gallon, closed-top drums. When a drum is filled, the bung will be secured tightly. Fluids may also be transferred to Baker® Tanks after being temporarily contained in drums to minimize the number of drums used.

When development and purging is completed, the water will be tested for appropriate hazardous waste constituents. Compositing and sampling of fluids will comply with applicable state and federal regulations.

#### D. Solids

The soil cuttings from well and boring drilling will constitute a large portion of the solids to be disposed of.

The solid waste stream also will include plastic sheeting used for decontamination pads, Tyveks, disposable sampling materials, and any other disposable material used during the field operations that appears to be contaminated. These materials will be placed in designated drums.

#### E. Storage and Disposal

The wastes generated at the site at individual locations will be transported to a centralized drum storage area by the drilling service subcontractor.

IDW in the central storage area will be characterized and disposed offsite by a commercial firm under subcontract. Disposal methods shall be in accordance with applicable solid waste, hazardous waste, and water quality regulations.

The liquid wastes meeting acceptable levels of discharge contamination may be disposed of through the sanitary sewer system at the site. Prior to disposal to the sanitary sewer system, contract arrangements will be made with the appropriate authorities. Wastes exceeding acceptable levels for disposal through the sanitary sewer system will be disposed of through contract with a commercial transport and disposal firm.

### IV. Attachments

None.

### V. Key Checks and Preventative Maintenance

Check that representative samples of the containerized materials are obtained and all drums are appropriately labeled according to the contents.

## STANDARD OPERATING PROCEDURE

# Water Level Measurements

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## I. Purpose and Scope

The purpose of this procedure is to provide a guideline for the measurement of the depth to groundwater in piezometers and monitoring wells, even where a second phase of floating liquid (e.g., gasoline) is encountered, and on-staff gages in surface-water bodies. This SOP includes guidelines for discrete measurements of static water levels and does not cover the use of continuously recording loggers.

## II. Equipment and Materials

- Electronic water-level meter (Solinst® or equivalent) with a minimum 100-foot tape; the tape should have graduations in increments of 0.01 feet or less
- Interface probe (Solinst® Model 122 Interface Meter or equivalent)

## III. Procedures and Guidelines

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the piezometer or well until the probe just contacts the water surface; the unit will respond with a tone or light signal. Note the depth from a reference point indicated on the piezometer or well riser. Typically this is the top of the protective casing. If no reference is clearly visible, measure the depth to water from the northern edge of the riser. If access to the top of the riser is difficult, sight across the top of the locking casing adjacent to the measuring point, recording the position of the cable when the probe is at the water surface.

Measure the distance from this point to the closest interval marker on the tape, and record the water level reading in the logbook. Water levels will be measured to the nearest 0.01-foot. Also measure and record the three following readings: (1) the depth of the piezometer or well; (2) the distance from the reference point to the top of the protective casing; and (3) the distance to the surface of the concrete pad or to ground. The depth of the piezometer or well may be measured using the water-level probe with the instrument turned off.

Free product light or dense nonaqueous phase liquid may be present in the piezometer or well. If the presence of free product is suspected, the thickness of the product should be determined using appropriate equipment (e.g., Solinst® Model 122 Interface Meter). The depth to water also is determined with this equipment and the water-level meter should not be used in the piezometer or well as long as product is present. Typically, a constant sound is emitted from the device when free product is encountered and an alternating on/off beep sound is emitted when water is encountered.

The apparent elevation of the water level in the well or piezometer is determined by

measuring both the apparent depth to water and the thickness of free product. The corrected water-level elevation is calculated by the following equation:

$$WL_c = WL_a + (\text{Free-product thickness} \times 0.80)$$

Where  $WL_c$  = Corrected water-level elevation

$WL_a$  = Apparent water-level elevation

0.80 = Specific gravity of petroleum hydrocarbon products.

If free product is detected on the surface of the water in the piezometer or well, the value of sampling should be reconsidered because of the potential for contaminating the sampling equipment.

Staff gages will be installed in some surface-water bodies. These facilities typically are constructed by attaching a calibrated, marked staff gage to a wood or metal post, driving the post into the bottom of the surface-water body, and surveying the elevation of the top of the post to a resolution of 0.01-foot. The elevation of the water in the surface-water body then can be determined by reading off the distance the water level is from the top of the post. A shield or other protection may be needed to calm the fluctuations in water level if the gage is installed at a location exposed to wind.

## IV. Attachments

None

## V. Key Checks

Before each use, verify that the battery is charged by pressing the test button on the water-level meter. Verify that the unit is operating correctly by testing the probe in distilled or de-ionized water. Decontaminate interface probe or water-level meter thoroughly between wells. Leave the unit turned off when not in use.

## STANDARD OPERATING PROCEDURE

# Groundwater Sampling from Monitoring Wells

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## I. Purpose and Scope

This procedure presents general guidelines for the collection of groundwater samples from monitoring wells. The procedure does not address purging and sampling using “low-flow” techniques (see SOP *Low-Flow Groundwater Sampling from Monitoring Wells*). Operations manuals should be consulted for specific calibration and operating procedures.

## II. Equipment and Materials

- Probe box with inlet/outlet ports for purged groundwater and watertight ports for each probe
- pH meter: Orion® Model SA250 or equivalent
- Temperature/conductivity meter: YSI® Model 33 or equivalent
- Dissolved oxygen meter: YSI® Model 57 or equivalent
- In-line disposable 0.45µm filters: QED® FF8100 or equivalent
- Teflon® bailer
- Peristaltic pump, bladder pump, or submersible sampling pump with tubing, support cables, and power supply (may not be required if well yield is low)

## III. Procedures and Guidelines

### A. Setup and Purging

1. For the well to be sampled, information is obtained on well location, diameter(s), depth, and screened interval(s), and the method for disposal of purged water.
2. A PID reading will be taken at each well immediately after removing the well cap to alert field personnel to the possible presence of contaminant fumes.
3. A pump will be used for well purging if the well yield is adequate; otherwise, a Teflon® bailer may be used.
4. Instruments are calibrated according to manufacturer's instructions.
5. The well number, site, date, and condition are recorded in the field

logbook.

- 6 Plastic sheeting is placed on the ground, and the well is unlocked and opened. All decontaminated equipment to be used in sampling will be placed only on the plastic sheeting until after the sampling has been completed
7. Water level measurements are collected in accordance with SOP *Water Level Measurements*, and the total depth of the well is measured.
8. The volume in gallons of water in the well casing or sections of telescoping well casing is calculated as follows:

$$0.052 (\pi r^2 h) = 0.163 (r^2 h) = \text{gallons}$$

where:  $\pi = 3.14$

$r$  = Radius of the well pipe in inches

$h$  = height of water in well in feet

The volume of water in typical well casings may be calculated as follows:

2-inch diameter well:

$$0.163 \text{ gal/ft} \times \text{___ (linear feet of water)} = \text{gallons}$$

4-inch diameter well:

$$0.653 \text{ gal/ft} \times \text{___ (linear feet of water)} = \text{gallons}$$

6-inch diameter well:

$$1.469 \text{ gal/ft} \times \text{___ (linear feet of water)} = \text{gallons}$$

The initial field parameters of pH, specific conductance, and temperature of water are measured and recorded in the field logbook. The measurement probes are inserted into the probe box. The purged groundwater is directed through the box, allowing measurements to be collected before the water contacts the atmosphere.

9. Sampling equipment is cleaned and decontaminated prior to sampling in accordance with SOP *Decontamination of Personnel and Equipment*.
10. If a bailer is being used, it is removed from either its protective covering or the well casing and attached to a cord compatible with constituents and long enough to reach the bottom of the well. If a sampling pump is being used, the airline, discharge line, and support cable or rope is attached to the pump. The support line should bear the weight of the pump. If the well is purged using dedicated tubing, it is lowered into the well to the top of the screened zone.
11. The sampling device is lowered to the well interval from which the sample is to be collected. The pump intake will be placed above the top of the screen, where possible. If a bailer is being used, it is allowed to fill with a minimum of surface disturbance to prevent

sample water aeration. When the bailer is raised, the bailer cord must not touch the ground.

12. During purging, the field parameters are measured at least once for each well volume. In productive wells, the well purging end point is determined using the field measurements. In nonproductive wells, the well is repeatedly bailed dry to obtain a minimum of three well volumes, then allowed to recover before sampling.
13. Before groundwater samples are collected, the well will be purged until three to six well volumes of water are withdrawn or the well goes dry. Purging is stopped when field parameters have stabilized over three consecutive well volumes. Field parameters are considered stabilized when pH measurements agree within 0.1 units, temperature measurements agree within 1°C, and specific conductance and dissolved oxygen measurements agree within 10 percent. If these parameters do not stabilize, the sample shall be collected after six well volumes have been removed, and the anomalous parameters shall be brought to the Field Team Leader's attention.

#### B. Sample Collection

Once purging has been completed, the well is ready to be sampled. The elapsed time between completion of purging and collection of the groundwater sample from the well should be minimized. Typically, the sample is collected immediately after the well has been purged, but this is also dependent on well recovery. Samples shall be collected after the water level has recovered to 80 percent of its static level or 16 hours after completion of purging, whichever occurs first. If a monitoring well is bailed or pumped dry before three well volumes can be obtained, the sample shall be collected when a sufficient volume of water has accumulated in the well.

Samples will be placed in bottles that are appropriate to the respective analysis and that have been cleaned to laboratory standards. Each bottle typically will have been previously prepared with the appropriate preservative, if any.

The following information, at a minimum, will be recorded in the log book.

1. Sample identification (site name, location, and project number; sample name/number and location; sample type and matrix; time and date; sampler's identity)
2. Sample source and source description
3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method), volume of water purged prior to sampling, number of well volumes purged, and field parameter measurements
4. Sample disposition (preservatives added, laboratory sent to, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)
5. Additional remarks

The steps to be followed for sample collection are as follows:

1. The sampler dons clean phthalate-free protective gloves.
2. The cap is removed from the sample bottle, and the bottle is tilted slightly.
3. The sample is slowly poured from the bailer or discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing.
4. If VOC samples are being collected from the monitoring well, these samples are collected first. A bailer shall be used to collect the VOC sample. Groundwater is poured from the bailer in a slow, controlled fashion down the side of a tilted sample vial to minimize volatilization. The sample vial is then filled until a meniscus is visible, after which the sample is immediately capped. The vial is then inverted and gently tapped to ensure that there are no air bubbles present in the vial. If, after the initial filling bubbles are present, the vials shall be discarded and the VOC sampling effort shall be repeated. Refilling of vials will result in loss of preservatives. After the containers are sealed, sample degassing may cause bubbles to form. These bubbles shall be left in the container. These samples shall never be composited, homogenized, or filtered.
5. Following collection of VOC samples, remaining water samples shall be collected in the following order: SVOCs (semivolatile organic compounds), including polynuclear aromatic hydrocarbons (PAHs); metals; total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs), and natural attenuation parameters.
6. Water samples requiring filtering (i.e., those for metals analysis) shall be filtered through a 0.45  $\mu\text{m}$  membrane filter immediately (within five minutes) after sampling and prior to preservation. Exposure of samples to atmospheric oxygen shall be kept to a minimum. In-line filtration and use of disposable filter assemblies are preferred. If samples are filtered, the contractor shall prepare a blank by filtering Type II Reagent-Grade Water and submitting the blank for analysis for metals. This shall be done once per sampling round to assure that filtration does not bias sample results. Sample turbidity shall be recorded and reported.
7. With the exception of VOC vials, adequate space is left in each sample bottle to allow for expansion.
8. The pH of preserved samples shall be checked in the field by pouring a small amount of the water sample onto pH paper. The paper shall not touch the sample inside the container. Do not check the pH of acidified VOC samples. The preservation checks shall be documented in the chain-of-custody forms. One preserved VOC sample per day per sampling crew shall be checked with pH paper. The sole purpose of this sample is to check the pH of VOC samples, it shall not be submitted for analysis.



9. After a bottle is capped, it will be labeled clearly and carefully.
10. Samples are placed in appropriate containers. If necessary, packed with ice in coolers as soon as practical. Ice will be collected in an ice chest prior to mobilization and be ready for use as samples are gathered.
11. If the sampling device is dedicated, it is returned to the well and the well is capped and locked. Nondedicated samplers are cleaned and decontaminated in accordance with SOP *Decontamination of Personnel and Equipment*.

## IV. Attachments

None

## V. Key Checks and Preventative Maintenance

Maintain field equipment in accordance with the manufacturer's recommendations. This will include, but is not limited to:

- Inspect sampling pump regularly and replace as warranted
- Bring supplies for replacing the bladder if using a positive-displacement bladder pump
- Inspect tubing regularly and replace as warranted
- Inspect air/sample line quick-connects regularly and replace as warranted
- Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts

## STANDARD OPERATING PROCEDURE

# Low-Flow Groundwater Sampling from Monitoring Wells

---

## I. Purpose and Scope

This procedure presents general guidelines for the collection of groundwater samples from monitoring wells. Low-flow purging and sampling procedures are specifically addressed. Operations manuals should be consulted for specific calibration and operating procedures.

## II. Equipment and Materials

- Flow-through cell with inlet/outlet ports for purged groundwater and watertight ports for each probe
- pH/Eh meter. Orion® Model SA250 or equivalent
- Temperature/conductivity meter: YSI® Model 33 or equivalent
- Dissolved oxygen meter: YSI® Model 57 or equivalent
- Water-level indicator
- In-line disposable 0.45 $\mu$  filters: QED® FF8100 or equivalent
- Bailer, teflon or stainless steel
- Adjustable-rate, positive-displacement pump
- Generator
- Disposable polyethylene tubing
- Plastic sheeting

## III. Procedures and Guidelines

### A. Setup and Purging

1. For the well to be sampled, information is obtained on well location, diameter(s), depth, and screened interval(s), and the method for disposal of purged water.
2. Instruments are calibrated according to manufacturer's instructions.
3. The well number, site, date, and condition are recorded in the field logbook.
4. Plastic sheeting is placed on the ground, and the well is unlocked and opened. All decontaminated equipment to be used in sampling will be placed only on the plastic sheeting until after the sampling has been completed.
5. Water level measurements are collected in accordance with SOP

Water Level Measurements. **Do not measure the depth to the bottom of the well at this time** (in order to avoid disturbing any accumulated sediment). Obtain depth to bottom information from well installation log.

6. The initial field parameters of pH, specific conductivity, and temperature of water are measured and recorded in the field logbook. The measurement probes are inserted into the probe box. The purged groundwater is directed through the box, allowing measurements to be collected before the water contacts the atmosphere.
7. Sampling equipment is cleaned and decontaminated prior to sampling in accordance with *SOP Decontamination of Personnel and Equipment*.
8. Lay out polyethylene sheeting and place all equipment on the sheeting. To avoid cross-contamination, do not let any downhole equipment touch the ground surface.
9. Attach and secure the polyethylene tubing to the low-flow pump. Lower the pump slowly into the well and set it at approximately the middle of the screen. Place the pump intake at least two feet above the bottom of the well to avoid mobilization of any sediment present in the bottom. Start purging the well at 0.2 to 0.5 liters per minute. Avoid surging. Purging rates for more transmissive formations could be started at 0.5 to 1 liter per minute.
10. The water level should be monitored during purging, and ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well. (The water level should stabilize for the specific purge rate.) There should be at least one foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1 to 0.2 liters per minute) to avoid affecting well drawdown. The well should not be purged dry. If the recharge rate of the well is so low that the well is purged dry, then the contractor may wait until the well has recharged to a sufficient level and collect the appropriate volume of water for the sample with the pump.
11. During purging, the field parameters are measured frequently (every three to five minutes) until the parameters have stabilized. Field parameters are considered stabilized when the measurements agree within: 0.1 unit for pH, 1°C for temperature, 3 percent for conductivity, 10mv for redox potential, 10 percent for turbidity and dissolved oxygen.

B. Sample Collection

Once purging has been completed, the well is ready to be sampled. The elapsed time between completion of purging and collection of the groundwater

sample from the well should be minimized. Typically, the sample is collected immediately after the well has been purged, but this is also dependent on well recovery.

Samples will be placed in bottles that are appropriate to the respective analysis and that have been cleaned to laboratory standards. Each bottle typically will have been previously prepared with the appropriate preservative, if any.

The following information, at a minimum, will be recorded in the logbook:

1. Sample identification (site name, location, and project number; sample name/number and location, sample type and matrix; time and date; sampler's identity)
2. Sample source and source description
3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method), volume of water purged prior to sampling, number of well volumes purged, and field parameter measurements
4. Sample disposition (preservatives added; laboratory sent to, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)

The steps to be followed for sample collection are as follows:

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.
2. The sample is slowly discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs. Samples may be field filtered before transfer to the sample bottle. Filtration must occur in the field immediately upon collection. Inorganics, including metals, are to be collected and preserved in the filtered form as well as the unfiltered form. The recommended method is through the use of a disposable in-line filtration module (0.45 micron filter) using the pressure provided by the pumping device for its operation.
3. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to overflowing and capped.
4. The bottle is capped, then labeled clearly and carefully.
5. Samples are placed in appropriate containers and, if necessary, packed with ice in coolers as soon as practical. Ice will be collected in an ice chest prior to mobilization and be ready for use as samples are gathered.
6. If the sampler is dedicated, it is returned to the well and the well is capped and locked. Nondedicated samplers are cleaned and decontaminated in accordance with SOP *Decontamination of Personnel and Equipment*. Disposable polyethylene tubing is disposed of with PPE and other site trash.

## **IV. Attachments**

None.

## **V. Key Checks and Preventative Maintenance**

Maintain field equipment in accordance with the manufacturer's recommendations. This will include, but is not limited to:

- Inspect sampling pump regularly and replace as warranted
- Inspect air/sample line quick-connects regularly and replace as warranted
- Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts

## STANDARD OPERATING PROCEDURE

# Soil Boring Sampling–Split Spoon

---

## I. Purpose

To provide a general procedure for sampling subsurface soil produced from a split spoon.

## II. Scope

The scope of this procedure is to cover the sample team's responsibility beginning with the opening of the split spoon.

## III. Equipment and Materials

- Latex or surgical gloves
- Stainless steel tray or pan
- Field notebook
- Stainless steel spoon or spatula
- Sampling jars
- Decontamination solutions and equipment

## IV. Procedures and Guidelines

1. Field team personnel will wear latex or surgical inner gloves and nitrile or neoprene outer gloves to protect from potential dermal contact with hazardous substances.
2. Each time a split-spoon sample is taken, a standard penetration test shall be performed in accordance with ASTM D-1586 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils." The sample is obtained by driving the sampler a distance of 1 foot into undisturbed soil with a 140-pound hammer free falling a distance of 30 inches. The sampler is first driven 6 inches to seat it in undisturbed soil; then the test is performed. The number of hammer blows for seating the spoon and making the test are then recorded for each 6 inches of penetration on the drill log (i.e., 5/7/8). The standard penetration test result (N) is obtained by adding the last two figures (i.e., 7+8=15 blows per foot). The sampler is then driven an additional 6 inches to fill the remainder of the split-spoon prior to retrieval.
3. After the split spoon is removed from the borehole and opened by the driller or driller's assistant, it will be turned over to field team personnel.
4. At each borehole, split-spoon samples shall be screened in the field to determine which samples will be retained for laboratory analysis. In general,

screening procedures shall consist of 1) PID measurements along the length of the split-spoon sample; and 2) inspection of the soil sample for discoloration, staining, and odors. Field screening results shall be recorded on the soil boring log.

Under favorable field conditions, the soil sample will be screened for evidence of contamination as soon as the split-spoon is opened. The samples will be cut longitudinally to allow for immediate PID screening.

If cool or damp conditions prevent the implementation of the approach described above, then a portion of each split spoon sample will be placed in a plastic ziplock bag and allowed to warm in the field vehicle. A portion of the remaining sample from that depth interval will be placed into appropriate sample jars. Within one hour after sample collection, PID readings will be measured in each of the bagged samples.

5. Unless noted otherwise in the Site Sampling Plans (Appendix A), soil samples will be retained for laboratory analysis from the depth intervals exhibiting the most evidence of contamination, based on soil screening procedures described above. If no evidence of contamination is observed in a borehole, then a sample shall be retained from the depth interval immediately above the water table. Deviations from this general selection procedure are noted in the Site Sampling Plans provided in Appendix A.
6. Samples selected for laboratory analysis shall be transferred to sample jars using a stainless steel utensil. Samples for VOC analyses will be separated and transferred first, followed by semivolatile samples. For volatile samples, mixing of soil shall be avoided before and during transfer. The remainder of the soil selected for laboratory analyses shall be homogenized in a stainless steel bowl using a stainless steel trowel or scoop. Homogenization procedures are described in detail in the SOP, *Homogenization of Soil and Sediment Samples*, provided in Appendix B.
7. Split spoon and media transfer tools will be decontaminated before being used again.

## V. Attachments

None.

## VI. Key Checks and Items

- Latex or surgical gloves.
- Decontaminate split spoon and transfer tools before next sample.
- Sample volatiles first, then semivolatiles. Avoid mixing.

## STANDARD OPERATING PROCEDURE

# Homogenization of Soil and Sediment Samples

---

## I. Purpose

The homogenization of soil and sediment samples is performed to minimize any bias of sample representativeness introduced by the natural stratification of constituents within the sample.

## II. Scope

Standard techniques for soil and sediment homogenization and equipment are provided in this SOP. These procedures do not apply to aliquots collected for VOCs or field GC screening; samples for these analyses should NOT be homogenized

## III. Equipment and Materials

Sample containers, stainless steel spoons or spatulas, and stainless steel pans.

## IV. Procedures and Guidelines

Soil and sediment samples to be analyzed for semivolatiles, pesticides, PCBs, metals, cyanide, or field XRF screening should be homogenized in the field. After a sample is taken, a stainless steel spatula should be used to remove the sample from the split spoon or other sampling device. The sampler should not use fingers to do this, as gloves may introduce organic interference into the sample.

Samples for VOCs should be taken immediately upon opening the spoon and should not be homogenized.

Prior to homogenizing the soil or sediment sample, any rocks, twigs, leaves, or other debris should be removed from the sample. The sample should be placed in a decontaminated stainless steel pan and thoroughly mixed using a stainless steel spoon. The soil or sediment material in the pan should be scraped from the sides, corners, and bottom, rolled into the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample should be mixed individually, and then rolled to the center of the pan and mixed with the entire sample again.

All stainless steel spoons, spatulas, and pans must be decontaminated following procedures specified in SOP *Decontamination of Personnel and Equipment* prior to homogenizing the sample. A composite equipment rinse blank of homogenization equipment should be taken each day it is used.



## STANDARD OPERATING PROCEDURE

# Shallow Soil Sampling

---

## I. Purpose

To provide general guidelines for the collection and handling of surface soil samples during field operations.

## II. Scope

The method described for surface soil sampling is applicable for loosely packed earth and is used to collect disturbed-soil samples.

## III. Equipment and Materials

- Sample jars.
- A hand auger equipped with 3-inch diameter cylindrical stainless steel bits.
- A stainless steel spatula should be used to remove material from the sampling device.

## IV. Procedures and Guidelines

1. Field team personnel will wear latex or surgical inner gloves and nitrile or neoprene outer gloves to protect from potential dermal contact with hazardous substances.
2. Use a decontaminated stainless steel scoop/trowel to scrape away surficial organic material (grass, leaves, etc.) at the sampling site. New disposable scoops or trowels may also be used to reduce the need for equipment blanks.
3. Obtain soil sample by scooping soil using the augering scoop/trowel, starting from the surface and digging down to a depth of about 6 inches, or the depth specified in the workplan.
4. Take a PID reading of the sampled soil and record the response in the field notebook. Also record lithologic description and any surface conditions that may affect the chemical analyses, such as the following: (1) asphalt chunks that may have been shattered by mowers, thus spreading small fragments of asphalt over the sampling area, (2) distance to roadways, aircraft runways, or taxiways, (3) obvious, deposition of contaminated or clean soil at the site, (4) evidence of dumping or spillage of chemicals, (5) soil discoloration, and/or (6) unusual condition of growing plants, etc.
5. Empty the contents of the scoop/trowel into a decontaminated stainless steel

pan.

6. Repeat this procedure until sufficient soil is collected to meet volume requirements.
7. For VOC samples, fill sample jars directly with the trowel/scoop and cap immediately upon filling. DO NOT HOMOGENIZE.
8. For PCBs, SVOCs, and metals, homogenize cuttings in the pan using a decontaminated stainless steel utensil.
9. Transfer sample for analysis into appropriate containers with a decontaminated utensil.
10. Backfill the hole with vermiculite. To the extent possible, replace topsoil and grass and attempt to return appearance of sampling area to its pre-sampled condition.

## **V. Attachments**

None

## **VI. Key Checks and Items**

- Phthalate-free latex or surgical gloves and other personal protective equipment.
- Transfer volatiles first, avoid mixing.
- Decontaminate utensils before reuse, or use dedicated, disposable utensils.

## STANDARD OPERATING PROCEDURE

# Surface Water Sampling

---

## I. Purpose and Scope

This procedure presents the techniques used in collecting surface water samples. Materials, equipment, and procedures may vary; refer to the Field Sampling Plan and operators manuals for specific details.

## II. Materials and Equipment

Materials and equipment vary depending on type of sampling; the Field Sampling Plan should be consulted for project-specific details.

- Open tube sampler
- Dip sampler
- Weighted bottle sampler
- Hand pump
- In-line disposable 0.45 µm filters
- Kemmerer or Van Dorn sampler
- Depth-integrating sampler
- Sample containers
- Meters for specific conductance, temperature, pH, and dissolved oxygen

## III. Procedures and Guidelines

Before surface water samples are taken, all sampler assemblies and sample containers are cleaned and decontaminated as described in SOP, *Decontamination of Personnel and Equipment*.

Surface water samples are collected manually by submerging a weighted bottle sampler. Weighted bottle samplers are lowered below water surface, where the attached bottle is opened, allowed to fill, and pulled out of the water. When retrieved, the bottle is tightly capped and removed from the sampler assembly. Specific types of weighted bottle samplers that can be used are Kemmerer and Van Dorn, and are acceptable in most instances. If approved by AFCEE, surface water samples may be collected by directly filling sample bottles.

The sample collection sequence is as follows: (1) if sampling both water and sediment or just sediment, start at the most downstream point and proceed upstream, (2) if sampling water only and the sample can be taken without disturbing the river or stream bottom, obtain any background samples first, then the farthest downstream sample, and then move upstream toward the source or discharge point, (3) if sampling water only and the stream or river bottom must be disturbed, start at the most downstream point and proceed upstream,

Samples shall be taken from the active portion of the stream on the side nearest the source of contamination or suspected plume.

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.
2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle.
3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.
4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time.
5. Water samples requiring filtering (i.e., those for metals analysis) shall be filtered through a 0.45 µm membrane filter immediately (within five minutes) after sampling and prior to preservation. Exposure of samples to atmospheric oxygen shall be kept to a minimum. In-line filtration and use of disposable filter assemblies are preferred. If samples are filtered, the contractor shall prepare a blank by filtering Type II Reagent-Grade Water and submitting the blank for analysis for metals. This shall be done once per sampling round to assure that filtration does not bias sample results. Sample turbidity shall be recorded and reported.
6. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.
7. Record the following information in the logbook: (1) the width, depth, and flow rate of streams, (2) surface water conditions (e.g., floating oil or debris, gassing), (3) the location of any discharge pipes, sewers, or tributaries, and (4) instrument calibration.
8. Permanently mark the location where surface water samples are collected (e.g., flagged stake in stream bank). Record the location on a project map for each specific site or zone. Survey the sample location using global positions system (GPS).

## IV. Attachments

None.

## V. Key Checks and Items

- Log exact locations using permanent features
- Beware of hidden hazards

## STANDARD OPERATING PROCEDURE

# Sediment Sampling

---

## I. Purpose

These general outlines describe the collection and handling of sediment samples during field operations

## II. Scope

The sediment sampling procedures generally describe the equipment and techniques needed to collect representative sediment samples. Operators manual, if available, should be consulted for specific details

## III. Equipment and Materials

- Sample collection device (hand corer, scoop, dredge, grab sampler, or other suitable device)
- Stainless steel spoon or spatula for media transfer
- Measuring tape
- Log book
- Personal protection equipment (rubber or latex gloves, boots, hip waders, etc.)
- Materials for classifying soils, particularly the percentage of fines
- Sample jars, including jars for Total Organic Carbon and pH, as appropriate

## IV. Procedures and Guidelines

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas.
2. Make a sketch of the sample area showing important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc)
3. Transfer sample into appropriate sample jars with a stainless steel utensil. Be especially careful to avoid the loss of the very fine clay/silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within

the sample matrix. Decant the water off of the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment since gloves may introduce organic interference into the sample. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay.

4. Samples for volatile organics should immediately be placed in jars. Rocks and other debris should be removed before placement in jars.
5. For the remaining analytical parameters, homogenize the sample according to the SOP, *Homogenization of Soil and Sediment Samples*.
6. Record the sample location on a project map for each specific site or zone. Survey the sample location using global positions system (GPS).
7. Follow the site safety plan designed for the specific nature of the site's sampling activities and locations
8. Decontaminate all sampling implements and protective clothing according to prescribed procedures.

## V. Attachments

None.

## VI. Key Checks and Items

- Start downstream, work upstream
- Log exact locations using permanent features.
- Beware of hidden hazards

## STANDARD OPERATING PROCEDURE

# Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, and Temperature Using the Horiba® U-10

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## I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for using the Horiba® U-10 for field measurements of pH, specific conductance, turbidity, dissolved oxygen, and temperature of groundwater samples. The operator's manual should be consulted for detailed operating procedures.

## II. Equipment and Materials

- Horiba® U-10 Water Quality Checker
- Distilled water in squirt bottle
- Horiba® U-10 Auto-Calibration Standard Solution

## III. Procedures and Guidelines

### A. Technical:

<u>Parameter</u>	<u>Range of measurement</u>
pH	0 - 14 pH
Specific Conductivity	0 - 100 mS/cm
Turbidity	0 - 800 NTU
Dissolved Oxygen	0 - 19.9 mg/l
Temperature	0 - 50 °C
Salinity	0 - 4 %

### B. Calibration:

Calibrate prior to initial daily use with Horiba® Standard Solution. Clean probe and calibration beaker with deionized water. Calibration procedure:

1. Fill the calibration beaker to about 2/3 with the standard solution.
2. Fit the probe over the beaker. All the parameter sensors will now be immersed in the standard solution except the D.O. sensor; the D.O. calibration is done using atmospheric air.
3. Turn power on.

4. Press **MODE** key to put the unit in the **MAINT** mode. The lower cursor should be on the **AUTO Sub-Mode**; if it is not, use the **MODE** key to move the lower cursor to **AUTO**.
5. With the lower cursor on **AUTO**, press the **ENT** Key. The readout will display **CAL**. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one by one: **pH**, **COND**, **TURB**, and **DO**. When the calibration is complete, the readout will briefly show **END** and then switch to the **MEAS** mode. The instrument is now calibrated.
6. If the unit does not switch to the **MEAS** mode, and the readout displays either **Er3** or **Er4**, an auto-calibration error has occurred. Parameters will blink where an error occurred (i.e. the **pH** will blink if the error occurred with the **pH** calibration). If this occurs re-do the auto-calibration. First, press the **CLR** Key to cancel the error code. Next, press the **ENT** Key to restart the auto-calibration. If the error message continues consult the operator's manual.

#### C. Sample Measurement

If dissolved oxygen is being measured and the sample water is being pumped, a flow-through cell will be used for parameter measurement. The probe will be tightly sealed in the flow-through cell and the parameter measurements taken. Otherwise, pour the sample into a small beaker and place the probe in the sample. Note and record the reading. Rinse the probe with deionized water when done.

## IV. Key Checks and Preventive Maintenance

- Ensure that copies of all field instrument operation manuals are readily available to the field team.
- Calibrate meter.
- Clean probe with deionized water when done.
- When reading results, note sensitivity settings.
- Refer to operations manual for recommended maintenance.
- Check batteries, and have a replacement set on hand.



# TAB

*Appendix C - Forms*

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## **APPENDIX C**

### **EXAMPLE FIELD FORMS**

PROJECT NUMBER	BORING NUMBER	SHEET	OF
SOIL BORING LOG			

PROJECT \_\_\_\_\_ LOCATION \_\_\_\_\_  
ELEVATION \_\_\_\_\_ DRILLING CONTRACTOR \_\_\_\_\_  
DRILLING METHOD AND EQUIPMENT \_\_\_\_\_  
WATER LEVELS \_\_\_\_\_ START \_\_\_\_\_ FINISH \_\_\_\_\_  
LOGGER \_\_\_\_\_

[illegible]



PROJECT NUMBER \_\_\_\_\_

WELL NUMBER \_\_\_\_\_

# MONITORING WELL CONSTRUCTION DETAILS

PROJECT \_\_\_\_\_ LOCATION \_\_\_\_\_

DRILLING CONTRACTOR \_\_\_\_\_

DRILLING METHOD AND EQUIPMENT \_\_\_\_\_

START \_\_\_\_\_ FINISH \_\_\_\_\_ LOGGER \_\_\_\_\_ WATER LEVEL AND DATE \_\_\_\_\_

Ground Surface

1) Ground elevation at well \_\_\_\_\_

2) Top of casing elevation \_\_\_\_\_

3) Wellhead/protective cover description \_\_\_\_\_

4) Diameter/type of surface casing(s) \_\_\_\_\_

a) Quantity(s) of surface casing grout used \_\_\_\_\_

5) Diameter/type of well casing \_\_\_\_\_

6) Type/slot size of screen \_\_\_\_\_

7) Type screen filter \_\_\_\_\_

a) Quantity used \_\_\_\_\_ size \_\_\_\_\_

8) Type of seal \_\_\_\_\_

a) Quantity used \_\_\_\_\_

9) Grout \_\_\_\_\_

a) Grout mix used \_\_\_\_\_

b) Method of grout placement \_\_\_\_\_

c) Quantity of well casing grout used \_\_\_\_\_

10) Development method (see reverse) \_\_\_\_\_

11) Development Time \_\_\_\_\_

12) Estimated volume of water purged \_\_\_\_\_

13) Comments \_\_\_\_\_

Note. All measurements are from ground surface.

Well Number \_\_\_\_\_

Sample ID Number \_\_\_\_\_

Development Start date timeDevelopment End date time

Development Method \_\_\_\_\_

Development Equipment: \_\_\_\_\_

Quantity of Water Loss During Drilling (if applicable) \_\_\_\_\_ gal Casing Diameter \_\_\_\_\_ in

Pre-Dev Static Water Level \_\_\_\_\_ Well TD \_\_\_\_\_ ft BTOC \_\_\_\_\_ Maximum Pumping Rate \_\_\_\_\_ gpm

One Well Volume of Water \_\_\_\_\_ gal

Total Quantity of Water Bailed \_\_\_\_\_ gal

Total Quantity of Water Discharged by Pumping \_\_\_\_\_ gal

Discharge Water Containerized? Y / N      Type of Containment \_\_\_\_\_

[illegible]

## Installation

Well Number \_\_\_\_\_

Site/Project \_\_\_\_\_

Sample ID Number \_\_\_\_\_

Project Number \_\_\_\_\_

Purge Start date time

Purged by \_\_\_\_\_

Purge End date time

Well Head Reading \_\_\_\_\_ ppm

Depth Measurement Reference Point \_\_\_\_\_

Well Casing ID: 2' 4' 6' Other \_\_\_\_\_

Depth to Top and Bottom of Screen \_\_\_\_\_ ft bgs

Original Depth to Water (DTW) \_\_\_\_\_

Final Depth to Water (DTW) \_\_\_\_\_

**Purge Method**

Submersible Pump ☐      Dedicated Bladder Pump ☐      Bladder Pump ☐      Bailer ☐      SS ☐      Tef ☐      Centrifugal Pump ☐      Peristaltic Pump ☐      Hand Pump ☐      Gas Lift/Displacement Pump ☐      Other

PVC ☐

Purging Equipment (Make, Model, Etc ) \_\_\_\_\_

Purging Equipment Decontaminated? — Y / N

Purge Water Containenzed? Y / N

Average Purge Rate \_\_\_\_\_ gpm

Weather \_\_\_\_\_ °F

[illegible]

*All Depths in Feet Below Reference Point on Wellhead - Generally Top of Casing (TOC)*

# MONITORING WELL SAMPLING LOG

Form Number \_\_\_\_\_

Installation \_\_\_\_\_

Well Number \_\_\_\_\_

Site/Project \_\_\_\_\_

Sample ID Number \_\_\_\_\_

Project Number \_\_\_\_\_

Sample Start date \_\_\_\_\_ time \_\_\_\_\_

Sampled by \_\_\_\_\_

Sample End date \_\_\_\_\_ time \_\_\_\_\_

Original Static Water Level \_\_\_\_\_ ft BTOC

Final Static Water Level \_\_\_\_\_ ft BTOC

Screen Interval \_\_\_\_\_ ft BTOC

Time	Temperature	pH	Conductivity	Turbidity	DO	Salinity

Are parameters 20% of purge values? Y / N

Repurge? Y / N

Number of repurge volumes \_\_\_\_\_

## Sampling Method

Submersible Pump ☐    Dedicated Bladder Pump ☐    Bladder Pump ☐    Bailer ☐    SS ☐    Tef ☐    PVC ☐    Centrifugal Pump ☐    Penstaitic Pump ☐    Hand Pump ☐    Gas Lift/Displacement Pump ☐    Other \_\_\_\_\_

Sampling Equipment (Make, Model, Etc.) \_\_\_\_\_

Sampling Equipment Decontaminated? Y / N

If pump or discrete bailer, depth(s) where pump set \_\_\_\_\_ ft BTOC

Weather \_\_\_\_\_ °F

## Lab Analyses

VOC ☐    SVOC ☐    Metals ☐    Pesticides/PCBs ☐    Herbicides ☐    TPH ☐    Dioxin/Furans ☐

Other \_\_\_\_\_

Metals    Filtered ☐    Unfiltered ☐    Both ☐

Field Duplicates Y / N

Split Sample Y / N

MS/MSD Y / N

Comments \_\_\_\_\_

BTOC = Below Top of Casing (or other measurement reference point)





# TAB

*SAP Part 2 – QAPP*

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**Installation Restoration Program  
Basewide Remedial Investigation / Feasibility Study Work Plan  
for  
Richards-Gebaur Air Force Base**

**QUALITY ASSURANCE PROJECT PLAN**

October 1999

Prepared for

**Air Force Center for Environmental Excellence (AFCEE)**  
Ms. Kay Grosinske, Contracting Officer's Representative  
IRP Program Office  
Brooks Air Force Base, Texas 78235

Prepared by

**CH2MHILL**

727 North First Street, Suite 400  
St. Louis, Missouri 63102

USAF Contract No. F41624-97-D-8019  
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# CH2M HILL/Richards-Gebaur AFB Quality Assurance Project Plan, Version 1.0

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## 1.0 Introduction

**The Air Force Center for Environmental Excellence Quality Assurance Project Plan (AFCEE QAPP), Version 3.0** (AFCEE, March 1998) in its entirety and this document will constitute the CH2M HILL/Richards-Gebaur Air Force Base (RGAFB) Quality Assurance Project Plan (CH2M HILL/RGAFB QAPP).

This QAPP was prepared for the Richards-Gebaur AFB environmental restoration projects being conducted under the U.S. Air Force Installation Restoration Program (IRP). The objectives of the IRP are to assess past hazardous waste disposal and spill sites at U.S. Air Force installations and to develop remedial actions consistent with the National Contingency Plan (NCP) for sites that pose a threat to human health and welfare or the environment.

This document contains the following sections:

- 1.0—Introduction
- 2.0—Quality Objectives
- 3.0—Field Instrument Calibration Procedures
- 4.0—Field Procedures
- 5.0—Reporting Limits
- 6.0—Clarifications of and Variances from the AFCEE QAPP, Version 3.0
- 7.0—Works Cited
- Attachment 1—Data Management Plan
- Attachment 2—Quality Control Criteria and Quantitation Limits
- Attachment 3—Laboratory EDD Format

To ensure compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA—also known as the “Superfund” act) and the 1986 Superfund Amendments and Reauthorization Act (SARA), the Department of Defense (DoD) developed the IRP, under the Defense Environmental Restoration Program, to identify potentially contaminated sites, investigate these sites, and evaluate and select remedial actions for potentially contaminated facilities.

The IRP is the DoD’s primary mechanism for response actions on U.S. Air Force installations affected by the provisions of SARA. In November 1986, in response to SARA and other U.S. Environmental Protection Agency (USEPA) interim guidance, the U.S. Air Force modified the IRP to provide for a Remedial Investigation/Feasibility Study (RI/FS) program that allowed RI/FS studies to be conducted as parallel activities rather than serial activities. The program now includes determining Applicable or Relevant and Appropriate Requirements (ARAR), identifying and screening remedial technologies, and developing remedial alternatives. The IRP might include multiple field activities and pilot studies prior to a detailed final analysis of alternatives. Over the years, requirements of the IRP have been developed and modified to ensure that DoD compliance with federal laws, such as the Resource Conservation and Recovery Act (RCRA), NCP, CERCLA, and SARA, can be met.

The Richards-Gebaur AFB Basewide RI/FS (Basewide RI/FS) that this CH2M HILL/RGAFB QAPP supports includes all activities CH2M HILL will perform. This CH2M HILL/RGAFB QAPP establishes the quality assurance/quality control (QA/QC) protocols and procedures that will govern sampling and analytical activities that are implemented for ongoing and potential future projects associated with the Basewide RI/FS.

This CH2M HILL/RGAFB QAPP may be updated periodically to reflect revisions to the AFCEE QAPP and revisions that may be initiated by Richards-Gebaur AFB, or AFCEE staff. Additional conceptual guidance for developing this CH2M HILL/RGAFB QAPP was derived from the AFCEE *Handbook for the Installation Restoration Program—Remedial Investigations and Feasibility Studies* (IRP Handbook) (AFCEE, 1993).

This QAPP presents the specific policies, organization, functions, and QA/QC activities associated with analytical data generation and assessment. This QAPP is designed to ensure that the data quality objectives (DQO) for the Basewide RI/FS are achieved. This QAPP provides guidance and also provides for modification to this guidance through project- or task-specific Work Plans, site-specific Field Sampling Plans (FSP), Sampling and Analysis Plans (SAP), and or addenda to these documents. Where modifications to this CH2M HILL/RGAFB QAPP are proposed, they must be described in the task-specific Work Plans, FSPs, SAPs, or addenda and approved by the regulatory agencies prior to implementation.

A key component of the data management and analytical generation and assessment process is the Data Management Plan (DMP). The Basewide RI/FS Data Management Plan is outlined in Attachment 1. The DMP provides operating guidelines for satisfying the data management requirements for large quantities of data. The DMP includes processes and guidelines for sample tracking, storage, access, delivery, and reporting of new chemical, analytical, geologic, and spatial data generated during Richards-Gebaur AFB investigation and cleanup operations. In addition, the DMP addresses the management of historical data.

This CH2M HILL/RGAFB QAPP is required reading for all staff participating in Basewide RI/FS projects. It must be referenced in all task-specific plans written to support these projects. If modifications to the guidance contained in this CH2M HILL/RGAFB QAPP are proposed, specific justification for the modifications must be provided.

Anticipated laboratory analytical variances to the AFCEE QAPP are listed in Section 6.0

## 1.1 Purpose and Scope

The purpose of this CH2M HILL/RGAFB QAPP is to establish the QA requirements in general for all investigations and analyses that occur in support of the Basewide RI/FS and to incorporate the AFCEE QAPP QA requirements into this document by reference. To fulfill this purpose, the scope of this CH2M HILL/RGAFB QAPP, which includes both this document and by reference the AFCEE QAPP, will ensure that the CH2M HILL/RGAFB QAPP is sufficiently flexible to accommodate the many small and large tasks, site types, and phases of work on the Basewide RI/FS, while conforming to AFCEE QAPP requirements. The use of this QAPP will be discussed in associated Work Plans.

## 1.2 Project Background

A project background description, including (1) the locations of sites, (2) a summary of the contamination history at each site, and (3) the findings from previous investigations, will be included in the Work Plans for specific Base activities.

### 1.3 Project Scope and Objectives

A summary of the objectives and the proposed work for each site will be included in the Work Plans. The intended use of the data acquired during this project, the DQO process, and a discussion of how the process-specific decision rules were derived will also be described. The Preamble to the IRP Handbook (AFCEE, 1993) states that all Air Force IRP projects should focus on the objectives resulting in direct cleanup actions and/or site closeouts.

### 1.4 Project Organization and Responsibilities

The Work Plan will describe the project organization and responsibilities, including (1) a project organizational chart identifying task managers and individuals responsible for performing the project, (2) descriptions of all key participants, and (3) the responsibilities of each key participant. Key participants include project, field, and laboratory QC officers, whose organization names and telephone numbers will be included in the Work Plan as provided in Section 3.0 of the AFCEE QAPP.

## 2.0 Quality Objectives

Quality objectives are essential to ensuring that data collected are sufficient to meet the intended goals. Quality objectives are pre-established goals or "bench marks" used to monitor and assess the progress of the project and the quality of the work performed. It is essential that quality objectives be defined prior to initiation of the project work to ensure that activities performed in support of the project yield data sufficient to meet the project objectives provided in Section 4.0 of the AFCEE QAPP.

Quality objectives are divided into two categories: DQOs and quality assurance objectives (QAO). DQOs are associated with the overall objective of the project as it relates to data collection. QAOs define the limits of acceptance for the project-generated data as they relate to data quality.

### 2.1 Use and Application of the QAPP

This CH2M HILL/RGAFB QAPP is an integral component of data quality planning and evaluation for all sampling and analysis activities in support of the Basewide RI/FS. A consistent and comprehensive approach for using this QAPP is necessary to ensure that sufficient data are produced that are of sufficient quality to enable decisions for all types of sites and phases of work.

In planning for analytical programs, each SAP will have established DQOs. DQOs specify the data type, quality, quantity, and uses needed to make decisions and are the basis for designing data collection activities. One of the goals of the DQO process is to use a QAPP to select the analytical methods needed to achieve the appropriate detection limits for data use.

Specifying the type, quantity, and quality of data needed for these potential data uses is not feasible within one functional QAPP. However, a QAPP does provide the minimum standards for data quality and required validation. These minimum standards are designed to provide a common baseline for creating comparable data. Each individual activity that generates data might need additional requirements that will be established in the project-specific DQOs and the project SAP. The guidance for establishing DQOs, as outlined in the

USEPA's *Guidance for the Data Quality Objectives Process: EPA QA/G-4* (USEPA, 1994), will be followed when planning for data collection. Furthermore, each site-specific Work Plan or SAP will incorporate the seven-step DQO process, as appropriate, using site-specific information as inputs to the DQO process. The Work Plans and/or SAPs must include acceptable limits for decision errors that will be used to establish appropriate performance goals for the data collection design.

The seven-step DQO process is as follows:

- Step 1: State the problem
- Step 2: Identify the decision
- Step 3: Identify the inputs to the decision
- Step 4: Define the boundaries of the study
- Step 5: Develop a decision rule
- Step 6: Specify acceptable limits on decision errors
- Step 7: Optimize the design

To properly implement the baseline requirements provided in this CH2M HILL/RGAFFB QAPP, project-specific DQOs and SAPs must consider the following factors in addition to those listed above.

### **2.1.1 Selection of Quantitation Limits**

The quantitation limits for a specific sampling effort are dictated by the intended use of the data and by guidance provided in Section 4.3 of the AFCEE QAPP. When monitoring to demonstrate progress toward achieving cleanup levels, the quantitation level must be low enough for the results of the analyses to be accurate at the concentration of the cleanup level.

The quantitation levels in this CH2M HILL/RGAFFB QAPP will be used to select appropriate analytical methods for a particular sampling program. The SAP can specify different quantitation limits for a method if the limits are achievable by the method (Section 4.3, AFCEE QAPP) and the limits are suitable for the intended use of the data. The AFCEE QAPP quantitation limits and those quantitation limits provided in Attachment 2 will serve in the absence of a requirement provided in a site-specific SAP.

### **2.1.2 Requirement for Data Validation**

The level of data validation required is a function of the data use. Data validation requirements are to be specified in the DQOs and SAP for each sampling effort. If a SAP does not specify the level of data validation, the requirements in Section 8.0 of the AFCEE QAPP will be followed. Section 2.3 of the IRP Handbook (AFCEE, 1993) provides a conceptual discussion of data validation objectives, requirements, and methods.

## **2.2 Quality Assurance Objectives**

Data are potentially subject to sampling and data reduction errors. QAOs are established to control the sources of errors and quantify the errors whenever possible. QC procedures are designed to increase sample data quality and help interpret discrepancies in the results. QAOs are quantifiable and qualifiable parameters that are expressed in terms of precision, accuracy, representativeness, comparability, and completeness (collectively referenced as PARCC). The QAOs established in this QAPP will be used for Work Plan development and

data quality review. The definitions and basis for assessing the PARCC parameters are discussed in Section 4.0 of the AFCEE QAPP.

### **3.0 Field Instrument Calibration Procedures**

Several types of real-time instruments can be used to monitor and evaluate the physical parameters of water and soil to determine the screening-level data. These screening level data can be used to monitor worker health and safety and to assist sample collection. Field instruments for Basewide RI/FS installation investigations will be described in the site-specific Work Plans. Standard Operating Procedures (SOP) or manufacturer's instructions will be part of a site-specific work plan.

## **4.0 Field Procedures**

This section includes brief descriptions of field procedures to be used to conduct investigations at Basewide RI/FS installations. Section 2.0 of the IRP Handbook (AFCEE, 1993) provides a general discussion of field procedures. Sample handling and custody procedures are more specifically described in Section 5.0 of the AFCEE QAPP.

The procedures will be divided into two parts: general field procedures and project-specific field procedures. General field procedures will be required for all projects that use this CH2M HILL/RGAFB QAPP. Project-specific procedures are highlighted in this CH2M HILL/RGAFB QAPP, but will not be discussed in detail. These project-specific procedures will be presented in the Work Plans associated with individual projects.

General field procedures (Section 4.1) include documentation, sample custody and security, sample shipment and handling, and equipment decontamination. Project-specific field procedures are presented in Section 4.2.

All personnel who will work on projects that use this CH2M HILL/RGAFB QAPP must read this CH2M HILL/RGAFB QAPP before planning or performing the fieldwork. Field activity coordinators and task leaders will ensure that field personnel have a copy of the CH2M HILL/RGAFB QAPP while in the field. All field activities must be conducted following health and safety procedures described in the project-specific Health and Safety Plan (HSP). Furthermore, the site-specific FSP and/or SAP will address special training requirements and certifications for personnel, if required.

### **4.1 General Field Procedures**

The primary objective of the documentation procedures section (Section 4.1.1) and the sample custody and security procedures section (Section 4.1.2) is to create an accurate written and/or electronic record suitable for tracking the possession and handling of all field samples. The sample shipment and handling procedures presented in Section 4.1.3 ensure that samples reach the appropriate laboratories intact and under appropriate custody. The equipment decontamination procedures presented in Section 4.1.4 ensure that cross-contamination across sampling sites does not occur.

#### **4.1.1 Documentation Procedures**

Guidance for documenting field samples includes Section 5.2 of the AFCEE QAPP and Section 2.1 1.1 of the IRP Handbook (AFCEE, 1993). The field activity coordinator is



responsible for ensuring that field-sampling teams adhere to proper custody and documentation procedures. Field logbooks, field forms, and chain-of-custody (CoC) forms will be the primary documentation mechanisms used to record and track information about each sample.

**4.1.1.1 Field Activities.** Field logbooks and field forms will be maintained as part of each field event. Copies of the field logbooks and field forms will be retained in the project files.

Field personnel have the following responsibilities regarding documentation of field activities:

- Keep accurate written records of all activities that occur on the site (including sample collection activities) on the field forms and/or field logbooks.
- Ensure that all entries are legible, written in waterproof, black ink, and contain accurate and inclusive documentation of the field activities. This documentation must include field data and observations, any problems encountered, and actions taken to solve the problem.
- Date and initial daily entries.
- Note errors or changes using a single line to cross out the entry, and date and initial the change.

Field logbooks and field forms will be available for review during technical systems audits or at any other time for QC checks. This documentation will provide verification of sampling procedures.

**4.1.1.2 Sample Labels and Identification.** A sample label will be affixed to each sample collected. Sample labels identify the sample with a unique identification number, the sample type (groundwater, soil, sediment, etc.), analytical method requested, the sampler's name(s) or initials, date collected, time collected, and the preservation method used. These labels will be completed in waterproof, black ink. Labels that have pre-printed sample IDs may be used; the remaining information is then completed at the time of sample collection. Use of additional tape to secure the sample labels is not recommended because of the potential for sample contamination from volatiles in the adhesives. Samples will be placed in plastic bags for storage and shipment to prevent sample loss or sample damage caused by melting ice, broken samples, or leaking samples.

**4.1.1.3 Photographs.** When photographs, slides, or movies are taken for visual documentation of a site or procedure, they will be numbered to correspond to the field logbook entries. If possible, a reference point (building, sign, etc.) will be included to assist in verifying the location of the photograph and provide an approximate scale. The name of the photographer, date, time, site location, and site description will be documented in the field logbook as photos are taken. The development and use of Photorecord forms that include space for all of these required data is encouraged. Photography will be coordinated with the Richards-Gebaur AFB field project manager (FPM) to ensure adherence to any security regulations.

## **4.1.2 Sample Custody and Security**

Guidance for sample handling and custody is included in Section 5.2 of the AFCEE QAPP. Sample custody during all sampling efforts must be traceable from the time of collection

until the results are verified and reported by the laboratory and the samples are disposed of. According to National Enforcement Investigation Center (NEIC) Policies and Procedures, May 1987, a sample is under custody if:

- It is in your possession
- It is in your view, after being in your possession
- It was in your possession and you locked it up
- It is in a designated secure area

Sample custody will be documented through the use of field records and CoC forms. These forms will be used to track sample custody from the point of sample collection through sample disposal. Security of samples will be ensured by the use of the procedures described below.

**4.1.2.1 Chain-of-Custody Forms.** A CoC form will be completed prior to sample shipment or release. Information required on the CoC forms is specified in Section 5.2 of the AFCEE QAPP. The form may include information for samples collected by one sampling team or for samples collected by multiple teams. The CoC form, sample labels, and field documentation are cross-checked to verify sample identification, type of analysis, number of containers, sample volume, preservatives, collection time, and type of sample container.

Information recorded on the CoC form includes.

- Sample identification
- Date and time of collection
- Analytical method(s) requested
- Sample matrix (e.g., soil or groundwater)
- Preservative (e.g., hydrochloric acid [HCl])
- Request for matrix spike analysis or other QC analysis
- Signature blocks for release and acceptance of samples
- Time blocks for release and acceptance of samples
- Any comments to identify special conditions or requests

An example CoC form is shown on Figure 1. Suppliers for individual projects may create project-specific CoC forms, but they must contain (at a minimum) the information listed above.

**4.1.2.2 Sample Custody during Shipment.** Completion of sample custody forms and sample packaging for shipment is performed in the supplier's staging area. Designated field and/or sample control staff will complete and verify CoC forms and pack samples for shipment at the end of each sampling day. When shipping or transferring samples, the shipping container(s) will have at least two custody seals affixed. One custody seal will be placed on the front of the container and one on the back in a manner that would indicate if the container had been opened during transit.

If samples are collected for onsite laboratory analysis, the sample control designee or field team member will log in the samples and release them to the onsite laboratory. Sample transfer between supplier staff or between supplier staff and courier, laboratory, etc., will be documented by signing and dating "relinquished by" and "received by" blocks whenever sample possession changes. Samples will be released for shipment by overnight couriers by noting the airbill number on the CoC form.

**4.1.2.3 Sample Security.** If samples are not shipped on the day of collection, they will be refrigerated or stored on ice in the sample staging area. Security is maintained by having locked supplier facilities in the staging area, a locked security fence surrounding the staging area and limited access to Basewide RI/FS sites.

#### **4.1.3 Sample Shipment and Handling**

A completed CoC form must accompany all sample shipments. The original CoC form will accompany the shipment and a copy of the form will be retained in the project file.

When samples are split for duplicate analysis, a separate CoC form will be prepared. The person relinquishing the samples to the facility or agency will request the signature of a representative to acknowledge sample receipt. If a representative is unavailable, a note will be made in the "Received By" space. When appropriate, as in the case of overnight shipment, the custody record will contain a statement that the samples were delivered to the designated location and the date and time of delivery noted. Sample collection and shipment will be coordinated to ensure that the receiving laboratory has staff available to process the samples according to method specifications.

**4.1.3.1 Sample Handling Procedures.** General requirements for sample handling are presented in Section 5.2 of the AFCEE QAPP. Following appropriate sample handling procedures will ensure that samples arrive at the laboratory intact, at the proper temperature, and free of external contamination. Samples may be shipped to designated laboratories via overnight carriers according to Department of Transportation standards, or project personnel or courier may deliver the samples to local laboratories. CoC procedures will be followed during any form of transport.

[illegible]

Any samples defined as hazardous materials will be packaged and shipped in accordance with requirements defined in the Code of Federal Regulations (CFR) (40 CFR 49, Chapter 1, Part 171). These requirements detail the proper classification and identification procedures for transporting hazardous materials.

When samples are required to be stored at 4°C or less, generous amounts of bagged ice will be packed with the samples. The ice will contact each sample and will be present at the top and bottom of the container. Samples will be cooled with ice or in a refrigerator (if available) before being packed for shipment.

The following procedures will be used to prevent bottle breakage and cross-contamination:

- Sample bottles will be sealed in individual plastic bags.
- All samples will be transported inside appropriate containers.
- All 40-milliter (mL) volatile organic analysis (VOA) bottles will be placed in blocks of foam or in plastic mesh sleeves.
- All other glass bottles will be placed in plastic mesh sleeves to prevent glass-to-glass contact.
- Bagged ice and/or foam blocks will be used to separate glass bottles.
- Vermiculite or absorbent paper will be used to absorb any sample that may leak during transport.
- The original CoC form will be packed inside the shipping container.
- The containers will be taped shut and sealed with strapping tape
- Samples that are known or suspected to be highly contaminated (based on field-screening data or observation) will be packaged and shipped separately from other samples.
- Laboratories will be notified of any known or suspected highly contaminated samples. These samples will be stored separately from less contaminated samples to minimize the potential for cross-contamination.

#### **4.1.4 Equipment Decontamination Procedures**

When dedicated equipment is not used for sampling (or purging, in the case of well sampling), the procedures described below are recommended for equipment decontamination. These procedures follow USEPA guidance (USEPA, 1992)

The minimum cleaning procedure for sampling equipment used when organic constituents are of interest will be:

- Wash the equipment with a non-phosphate detergent.
- Rinse the equipment with tap water.
- Rinse the equipment with pesticide-grade hexane or methanol.
- Rinse the equipment with ASTM Type II water.

If hexane or methanol are target analytes, a different solvent (that is not a target analyte) will be used (e.g., isopropanol).

The minimum cleaning procedure for sampling equipment used when inorganic constituents are of interest will be:

- Wash the equipment with a non-phosphate detergent.
- Rinse the equipment with tap water.
- Rinse the equipment with dilute (0.1 N) hydrochloric or nitric acid
- Rinse the equipment with ASTM Type II water.

Dilute hydrochloric acid will be used when cleaning stainless steel because nitric acid may oxidize the steel.

Equipment will be protected from dust and allowed to air-dry. Decontaminated equipment will not be allowed to touch the ground or contaminated surfaces. Equipment that will be stored for extended periods before re-use will be stored in a manner that protects it from dust and dirt. Protective packaging may include (but not be limited to) wrapping the equipment in aluminum foil and/or wrapping the equipment with plastic wrap. The equipment will be labeled as decontaminated for either organic or inorganic sampling and the decontamination date will be included on the label. Equipment blanks will be taken at a frequency specified in the site-specific FSP to ensure the equipment is free of contamination (from target analytes).

All waste decontamination fluids will be containerized and characterized for disposal according to procedures specified in each project-specific FSP.

## 4.2 Project-Specific Field Procedures

General guidance for field procedures is included in Section 2.0 of the IRP Handbook. Detailed equipment and procedure descriptions will be included in the project-specific FSP. These procedures will describe the QC specifications, field forms, stepwise descriptions of field procedures, and any special conditions or precautions that must be considered in the field. An HSP will be included as part of each FSP.

At a minimum, each project-specific FSP will address the field procedures listed below. The procedures will be described as they apply to each sample matrix (i.e., soil, sediment, sludge, groundwater, gas, or biota):

- Site selection
- Permits/clearances
- Drilling locations
- Sampling locations
- Sampling methodology and equipment
- Sample containers, preservation, and holding time requirements

- Field measurements
- Field recordkeeping
- Field schedules
- Preventative maintenance
- Waste management

It is understood that some of the procedures outlined above might not be required for a given project-specific FSP (e.g., a groundwater sampling program might not require a discussion of drilling locations). However, each procedure that will be required for individual projects will be described in the FSP for that project and will include the inspection/acceptance requirements, if needed, for supplies and consumables. Furthermore, each project-specific FSP will include the rationale for selecting the sampling locations, number of samples, and analyses to be performed.

## 5.0 Reporting Limits

In some cases, ARARs or action criteria might reflect levels that are below the reporting limits (RL) defined by the AFCEE QAPP. Laboratory-specific method detection limits (MDL) are lower than the RLs and might be used by the project team in decision processes. The laboratory MDLs will be provided prior to the start of sample analysis. The MDLs for some compounds could still be higher than the identified ARARs or action criteria. Developing new analytical methodologies and modifying existing protocols are normally both beyond the project scope. Therefore, the detection-level limitations will be compared during the project decision making process. Exceptions to the AFCEE RLs and accuracy and precision limits are included in Section 6.0. These exceptions have been reconciled with the Cleanup Levels for Missouri (CALM) and MCLs for those analytes that are compounds of potential concern and do not impact the attainment of the project data quality objectives outlined in the project work plan.

## 6.0 Clarifications of and Variances from the AFCEE QAPP, Version 3.0

The following sections and tables in the AFCEE QAPP are affected by variances specific to this project:

1. **SW8260B, Volatiles.** For the field QC samples (i.e., equipment blanks, trip blanks, rinseate blanks, etc.) associated with a soil batch, the laboratory will analyze the sample using soil QC and reporting criteria.
2. **Section 4.3.1, Method Detection Limits.** MDLs will be established and maintained as stated in 40 CFR 136, Appendix B.
3. **Section 6.1.1 (1020A).** Add USEPA Method 1010 (Ignitability by Pensky-Martens) as an optional alternative to Method 1020A.
4. **Section 6.1.6 and Section 6.1.7.** The table below represents the RL values that differ from the AFCEE QAPP and that will be followed for this program.

Method	Analyte	Water (mg/L)
--------	---------	--------------

E160.1	Total Dissolved Solids	20
E160.2	Total Suspended Solids	10

5. **Section 7.2.5 and Table 7.2.5-2 (SW8081A).** The following table represents variances to the accuracy limits:

Analyte	Accuracy Limits (Water)	Accuracy Limits (Soil)
Alpha-BHC	51 – 125	51 – 125
Delta-BHC	51 – 125	51 – 125
Endosulfan II	39 – 153	49 – 143
Endrin Aldehyde	33 – 144	43 – 134
Methoxychlor	58 – 125	47 – 148
DBCP	25-133	AFCEE Limits

6. **Section 7.2.5 (SW8081A) and Section 7.2.6 (SW8082).** For clarification of the AFCEE QAPP, the initial calibration will minimally consist of the following injections.

- Five-point, single-component organochlorine pesticides (including surrogates).
- Five levels of Toxaphene.
- Five levels of a mixture of Aroclors 1016 and 1260 that will suffice for linearity demonstration of all Aroclors (because they include all congeners present in the different regulated Aroclors). Aroclors 1221, 1232, 1242, 1248, and 1254 will be injected at concentrations equal to the AFCEE QAPP RLs for use in pattern recognition. If any of these Aroclor patterns are identified in a sample, a five-point calibration will be performed for the identified Aroclors to quantify the results.
- Calibration linearity for each Aroclor must be demonstrated no less than once annually.

7. **Section 7.2.6 and Table 7.2.6-2 (SW8082).** The surrogate DBCP water accuracy limit will be 25 – 133.

8. **Section 7.2.10 and Table 7.2.10-2(SW8270C).** The table below represents the accuracy limits that differ from the AFCEE QAPP and that will be followed for this program:

Analyte	Accuracy Limits (Water)	Accuracy Limits (Soil)
Hexachlorocyclopentadiene	25 – 125	AFCEE RL
4-Chloroaniline	AFCEE RL	15 – 73

9. **Section 7.2.14 and Table 7.2.14-14 (SW8330).** The table below represents the surrogates that may be used for this program and the associated control limits.



Surrogate	Accuracy Water (%R)	Accuracy Soil (%R)
1,3-DNT	50-150	50-150
1,4-Dinitrobenzene	50-150	50-150
3,4-DNT	75-125	75-125

10. **Section 7.2.15 and Table 7.2.15-1 (SW6010B).** The RL for sodium appears to be a typographical error in that, in the case of most elements, there is an approximate factor of 100 in the difference between the soil and water reporting limits. This is consistent with the preparation protocols between these two matrices. Therefore, the sodium RL will be raised to 100 mg/kg. The table below represents additional RL values that differ from the AFCEE QAPP to a lesser extent than sodium that will be followed for this program:

Analyte	Water (mg/L)	Soil (mg/kg)
Potassium	2.5	AFCEE RL
Sodium	AFCEE RL	100
Cobalt	0.01	AFCEE RL
Nickel	0.02	AFCEE RL

11. **Sections 7.2.17 through 7.2.27.** Method SW6010 (Section 7.2.15) can be substituted for the methods in these sections if the AFCEE RLs can be met and if it can be demonstrated that there are no interferences on the analytes when analyzing project samples using method SW6010. If used, all SW6010 QC criteria, except reporting limits, must be met for each analyte. The table below represents the RL value that differs from the AFCEE QAPP that will be followed for this project.

Analyte	Water (mg/L)	Soil (mg/kg)
Thallium	0.002	0.2

12. **Section 7.2.28 (SW9010B/SW9012A).** Soil analysis for cyanide will be performed by adding 5.0 grams of soil to the 250 mL of water and then adhering to the method as specified in the AFCEE QAPP. This method is a modification of USEPA CLP SOW ILM4.0 Exhibit D Method 335.2, "Method for Total Cyanide Analysis by Midi Distillation". The table below outlines the RL and Accuracy and Precision criteria that will be followed for this program.

Method	RL (mg/kg)	Accuracy (%R)	Precision (RPD)
SW9010B/SW9012A	0.5	75-125	<25

13. **Section 7.2.29.** Method SW9056 extraction method for soils will be as follows

- To 30 grams of soil, add 150 mL of deionized water and mix thoroughly in a 250-mL flask.

- Place in a horizontal shaker and shake for 2 hours. Adjust speed of shaker to produce a gentle swirling of the sample.
- Filter the extract through a Whatman® GF/A filter into a 50-mL plastic culture tube.
- Proceed with analysis using Method SW9056.

The 1:5 soil/water extraction method is derived from American Society of Agronomy Monograph # 9 Methods of Soil Analysis Part 2 Chemical and Microbiological Properties, Second Edition 1982. Chapter 10 discusses soluble salts and aqueous extracts. Section 10-2.3.2 describes the extraction using a 1:5 soil/water ratio, the shaking time is for 1 hour. In section 10-3 the solutes Cl, NO<sub>3</sub>, and SO<sub>4</sub> are listed as analytes.

- 14. Table 7.2-29-3 (SW9056).** The calibration verification acceptance criteria will be 90 to 110 percent of expected value.
- 15. Section 8.2, Data Review, Validation, and Reporting Requirements for Definitive Data.**
  - General Clarification for Data Users
    - Method Blank contamination—B flag detects and UB flag non-detects for analyte in all affected samples.
    - Matrix Spike/Matrix Spike Duplicate (MS/MSD) (% recovery or RPD exceedances)—M flag detects and UM flag non-detects for all associated samples.
- 16. Table 8.2-3, Flagging Conventions Specific to Organic Methods.** Internal standard and surrogate recoveries outside of criteria require a corrective action of reextraction and reanalysis. When reextraction and reanalysis yield similar results, the laboratories will flag the data as specified in the AFCEE QAPP. The prime contractor, during data validation, may use professional judgment to modify the laboratory flagging when a matrix effect has been clearly demonstrated.
- 17. Section 8.8, Hardcopy Data Reports For Screening and Definitive Data.** The analytical laboratory deliverables will be generated as described in the AFCEE QAPP. The forms submitted by the laboratory will be equivalent to those presented in the AFCEE QAPP, but need not be identical in format. Forms that do not follow the AFCEE protocol will be submitted to AFCEE for approval. For methods not included in the AFCEE QAPP and selected screening methods, an AFCEE-definitive method deliverable will be submitted by the laboratory.
- 18. An electronic data deliverable (EDD) file from the laboratory will be a comma delimited ASCII file in the format listed in Attachment 4.** The list of fields may vary slightly if agreed upon between the laboratory and the project data manager. There will be one file per hardcopy report and the filename of the EDD file will be in the format REPORTID.txt, where REPORTID is the hardcopy report identifier of sample delivery group.

The first row of the EDD will contain the field name values as listed in Attachment 4. The project data manager will provide the laboratory with a list of valid values that the

laboratory will use in constructing the EDD. Some sample valid values are listed in Attachment 4.

**19. AFCEE Screening Methods that require an AFCEE-definitive method deliverable:**

- Filterable Residue (E160.1)
- Nonfilterable Residue (E160.2)
- Alkalinity (E310.1)
- Total Organic Carbon (SW9060)

**20. Methods not included in the AFCEE QAPP, Version 3.0:**

- Radioactivity: Gross alpha/beta (E900.0); gross gamma (E901.1)
- Sulfides (SW9030)
- Acid Volatile Sulfides/Simultaneously Extracted Metals (USEPA Draft Method, 1991)
- Oil and Grease (USEPA, 1664)
- Hardness, Total (E130)
- Nitrogen, Ammonia (E350.1)
- Nitrate/Nitrite (E353)
- Anions: Nitrate/Nitrite, Nitrate, Nitrite, Ortho-Phosphate, Sulfate, Bromide, Fluoride, and Chloride (E300)
- Phosphorous, All Forms (E365)
- Sulfate (E375)
- Chloride (E325)
- Dissolved Gases in Water (RSK-175)
- Total Petroleum Hydrocarbons (Iowa DNR OA1 and OA2)
- Ferrous Iron (SM3500-Fe D)

Those methods listed that are not defined in Version 3.0 of the AFCEE QAPP and the selected screening methods are described in this section in the level of detail prescribed by the AFCEE QAPP. RLs and QC acceptance criteria and quantitation limits for these methods are listed in Attachment 2.

- 1. Method E900.0/E901.1—Radioactivity (Gross Alpha/Beta and Gamma).** USEPA 900.0 Gross alpha and gross beta: An aliquot of sample is evaporated or mounted onto a tarred stainless-steel counting planchette. The sample planchette and residue are dried and weighed and the weight of the residue is determined. The residue is then counted for alpha and beta by gas proportional counter

USEPA 901.1 Gamma spectroscopy: The sample is measured in standard calibrated geometry. Gamma radiation is measured using a shielded Ge (Li) or NaI (Ti) detector for a specified count time that is determined by the sensitivity requirements of the measurement. The radioactivity of gamma emitters is determined by the instrumentation and technical review of the gamma spectrum.

2. **Method SW9030—Total Sulfides (acid soluble + acid insoluble).** This method is suitable for the determination of total sulfides. Under acidic conditions, the sample is heated and hydrogen sulfide ( $H_2S$ ) is distilled and carried to scrubbing bottles containing zinc. The subsequent zinc sulfide precipitate is oxidized to sulfur with a known volume of excess iodine. The excess iodine is determined by titration with sodium thiosulfate. Quantitation is based on sodium thiosulfate.

3. **Acid Volatile Sulfides/Simultaneously Extracted Metals (USEPA Draft Method, April 1991).** The acid volatile sulfides (AVS) are converted to  $H_2S$  by acidification with HCl at room temperature. The  $H_2S$  is purged from the sample and trapped in sodium hydroxide (NaOH) solution. The amount of sulfide in the NaOH solution is then determined by adding a mixed diamine solution to develop color, and measuring the absorbance at 670 nanometers (nm). The measured absorbance is then compared to the absorbance of a standard sulfide solution.

The simultaneously extracted metals (SEM) are metals liberated during the HCl acidification step. The sample is filtered and the solution is analyzed by inductively coupled plasma (ICP), atomic absorption (AA), or cold vapor flameless AA for mercury. Quality control procedures associated with ICP, AA, and cold vapor, as defined in the AFCEE QAPP Version 2.0, will be adhered to in the analysis of the SEM samples.

4. **Method 1664—Oil and Grease.** This method is suitable for the determination of oil and grease in water matrices. This method replaces SW9070 and substitutes n-Hexane for freon as the extraction solvent. Gravimetry is used as the determinative method.
5. **Method E130.1/E130.2—Hardness, Total (mg/L as  $CaCO_3$ ).** USEPA 130.1: The magnesium ethylenediamine tetraacetate (MgEDTA) exchanges magnesium on a equivalent basis for any calcium and/or other cation to form a more stable EDTA chelate than magnesium. The free magnesium reacts with calmagite at a pH of 10 to give a red-violet complex. By measuring only magnesium concentration in the final reaction stream, an accurate measurement of total hardness is possible.

USEPA130.2: Calcium and magnesium ions in the sample are sequestered upon the addition of disodium ethylenediamine tetraacetate ( $Na_2EDTA$ ). The end point of the reaction is detected by means of Eriochrome Black T indicator, which has a red color in the presence of calcium and magnesium and a blue color when the cations are sequestered.

6. **Method E350.1/E350.2/E350.3—Nitrogen, Ammonia.** USEPA 350.1 Colorimetric, Automated Phenate: Alkaline phenol and hypochlorite react with ammonia to form indophenol blue that is proportional to the ammonia concentration. The blue color formed is intensified with sodium nitroprusside

USEPA 350.2 Colorimetric, Titrimetric, Potentiometric Distillation Procedure The sample is buffered at a pH of 9.5 with a borate buffer to decrease hydrolysis of cyanates and organic nitrogen compounds, and is then distilled into a solution of boric acid. The ammonia in the distillate can be determined colorimetrically by nesslerization, titrimetrically with standard sulfuric acid with the use of a mixed indicator, or potentiometrically by the ammonia electrode. The choice between the first two procedures depends on the concentration of the ammonia.

USEPA 350.3 Potentiometric, Ion-Selective Electrode: The ammonia is determined potentiometrically using an ion-selective ammonia electrode and a pH meter having an expanded millivolt scale or a specific ion meter.

7. **Method E353.1/E353.2/E353.3—Nitrate/Nitrite.** USEPA E353.1 Colorimetric, Automated, Hydrazine Reduction: Nitrate is reduced to nitrite with hydrazine sulfate and the nitrite (that originally present plus reduced nitrate) is determined by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye that is measured colorimetrically.

USEPA E353.2 Colorimetric, Automated, Cadmium Reduction: A filtered sample is passed through a column containing granulated copper-cadmium to reduce nitrate to nitrite. The nitrite (that originally present plus reduced nitrate) is determined by diazotizing with sulfanilamide and coupling that N-(1-naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye that is measured colorimetrically. Separate, rather than combined nitrate-nitrite, values are readily obtained by carrying out the procedure first with, and then without, the copper-cadmium reduction step.

USEPA E353.3 Colorimetric, Automated, Cadmium Reduction: A filtered sample is passed through a column containing granulated copper-cadmium to reduce nitrate to nitrite. The nitrite (that originally present plus reduced nitrate) is determined by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye that is measured spectrophotometrically. Separate, rather than combined nitrate-nitrite, values are readily obtained by carrying out the procedure first with, and then without, the copper-cadmium reduction step.

8. **Method E300—Nitrate/Nitrite, Nitrite, Nitrate, Chloride, Sulfate, Orthophosphate, Bromide, and Fluoride.** USEPA 300 Ion Chromatography: This method is used for measurement of multiple anions in water samples through the same analytical run. The mixture of anions is separated into the different anion fractions by diluting the mixture over a chromatographic column. The separation is followed by detection and quantification of the individual anion through an electrochemical detector.
9. **Method E365.1/E365.2/E365.3—Phosphorous, All Forms.** These methods cover the determination of specified forms of phosphorous in drinking, surface, and wastewaters. The methods are based on reactions that are specific for orthophosphate ion. Thus, depending on the treatment of the sample, various forms of phosphorous may be determined.
10. **Method E375.1/E375.2/E375.3/E375.4—Sulfate.** USEPA 375.1 Colorimetric, Automated, Chloranilate: When solid barium chloranilate is added to a solution containing sulfate, barium sulfate is precipitated, releasing the highly colored acid chloranilate ion. The color intensity in the resulting chloranilic acid is proportional to the amount of sulfate present.

USEPA 375.2 Colorimetric, Automated, Methylthymol Blue, AAll: The sample is first passed through a sodium-form cation exchange column to remove multivalent metal ions. The sample containing sulfate is then reacted with an alcohol solution of barium chloride and methylthymol blue (MTB) at a pH of 2.5 to 3.0 to form barium sulfate. The combined solution is raised to a pH of 12.5 to 13.0 so that excess barium reacts with MTB. The uncomplexed MTB color is gray; if it is all chelated with barium, the color is

blue. Initially, the barium and MTB are equimolar and equivalent to 300 mg sulfate ( $\text{SO}_4$ )/1; thus, the amount of uncomplexed MTB is equal to the sulfate present.

USEPA 375.3 Gravimetric: Sulfate is precipitated as barium sulfate ( $\text{BaSO}_4$ ) in a hydrochloric acid medium by the addition of barium chloride. After a period of digestion, the precipitate is filtered, washed with hot water until free of chloride, ignited, and weighed as  $\text{BaSO}_4$ .

USEPA 375.4 Turbidimetric: Sulfate ion is converted to a barium sulfate suspension under controlled conditions. The resulting turbidity is determined by a nephelometer, filter photometer, or spectrophotometer and compared to a curve prepared from standard sulfate solutions.

11. **Method E325.1/E325.2/E325.3—Chloride.** USEPA 325.1 Colorimetric, Automated Ferricyanide AAI: Thiocyanate ion ( $\text{SCN}$ ) is liberated from mercuric thiocyanate through sequestration of mercury by chloride ion to form un-ionized mercuric chloride. In the presence of ferric ion, the liberated  $\text{SCN}$  forms highly colored ferric thiocyanate in concentration proportional to the original chloride concentration.

USEPA 325.2 Colorimetric, Automated Ferricyanide AAI:  $\text{SCN}$  is liberated from mercuric thiocyanate through sequestration of mercury by chloride ion to form un-ionized mercuric chloride. In the presence of ferric ion, the liberated  $\text{SCN}$  forms highly colored ferric thiocyanate in a concentration proportional to the original chloride concentration.

USEPA 325.3 Titrimetric, Mercuric Nitrate: An acidified sample is titrated with mercuric nitrate in the presence of mixed diphenylcarbazone-bromophenol blue indicator. The end point of the titration is the formation of the blue-violet mercury diphenylcarbazone complex.

12. **Method RSK-175—Dissolved Gases in Water:** This method is applicable to the preparation and analysis of dissolved gases in water samples. The method is specifically for the determination of methane, ethene, and ethane, by an equilibration technique utilizing the Henry's law relationship.

A water sample is collected in two VOA vials. A headspace is created using high-purity helium. The samples are shaken to equilibrate the hydrocarbons between the water and helium headspace and a sample of the headspace is collected using a syringe. The sample is injected into a gas chromatograph (GC) equipped with a flame ionization detector (FID).

13. **Method E160.1—Filterable Residue:** A well-mixed sample is filtered through a standard glass fiber filter. The filtrate is evaporated and dried to a constant weight at  $180^\circ\text{C}$ .
14. **Method E160.2—Nonfilterable Residue:** A well-mixed sample is filtered through a glass fiber filter, then is dried to constant weight at  $103^\circ$  to  $105^\circ\text{C}$ .
15. **Method E310.1—Total Alkalinity:** An unaltered sample is titrated to an end point of pH 4.5 using hydrochloric or sulfuric acid. The alkalinity is measured as calcium carbonated equivalence.
16. **Method SW9060—Total Organic Carbon:** Organic carbon is measured using a carbonaceous analyzer. The instrument converts the organic carbon in a sample to

carbon dioxide by either catalytic combustion or wet chemical oxidation (including ultraviolet light [UV]-promoted, persulfate oxidation). The carbon dioxide formed is then either measured directly by an infrared detector or converted to methane and measured by an FID. The amount of carbon dioxide or methane in a sample is directly proportional to the concentration of carbonaceous material in the sample.

17. **Iowa DNR Method OA1—TPH-Volatile.** This method provides gas chromatographic conditions for the detection of certain volatile petroleum fractions such as gasoline. Samples are analyzed utilizing purge-and-trap sample concentration. A temperature program is used in conjunction with the gas chromatograph to facilitate separation of organic compounds. Detection is achieved by an FID or FID with photoionization detector (PID) in series or mass spectrometer (MS). Only PID is not acceptable for quantitation of the petroleum hydrocarbons.
18. **Iowa DNR Method OA2—TPH-Extractable.** This method covers the determination of low-volatility petroleum products and organic compounds that are soluble in moderate to low-polarity organic solvents and that are amenable to gas chromatography. A 1-Liter sample of liquid or 30-gram sample of solid is extracted. The extract is dried and concentrated. A flame ionization capillary gas chromatography method is used to quantitate the compounds or mixtures of interest; a gas chromatograph/mass spectrometer/data system may also be used.
19. **Method SM3500-Fe D—Ferrous Iron:** Ferrous iron ( $\text{Fe}^{2+}$ ) is determined colorimetrically. Soluble iron in groundwater is usually in the ferrous state. The complexing reagents used in the colorimetric procedures are specific for ferrous iron. Ferrous iron is easily changed to the ferric form ( $\text{Fe}^{3+}$ ) in solutions in contact with air; determination for ferrous iron requires analysis within 48 hours due to its instability.

## 7.0 Works Cited

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**Attachment 1**  
**Data Management Plan**

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## ATTACHMENT 1

# Data Management Plan

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## A1.1 Introduction

This Basewide Data Management Plan (DMP) was developed to provide operating guidelines for satisfying the data management requirements for large quantities of data. It is intended for use by consultants and laboratories engaged in site characterization and remedial activities on Richards-Gebaur AFB. Deviations from this DMP will be stated in project-specific Work Plans.

The DMP provides the processes and guidelines for sample tracking, storage, access, delivery, and reporting of new chemical analytical, geologic, and spatial data generated by investigation and cleanup operations. In addition, this plan addresses the management of historical data, if any exist. Key data management objectives are identified and listed below:

- Provide data users with tools that allow relatively simple and rapid access to stored data of various types.
- Provide methods of data entry with known accuracy and efficiency.
- Apply well-documented data validation modifications to the electronic database.
- Manage sample data using a unique sample identification number
- Establish a sample inventory of new data collected and provide methods of sample inventory reconciliation.
- Store and provide sample-specific attributes, including location identifier, sample type, sample media, depth, date, and target study area
- Provide reporting and delivery formats from a single database source to support data analysis, site characterization, risk assessment, modeling, and spatial analysis
- Provide the ability to electronically compare results to project-specific reference or screening criteria.
- Identify historical data needs and establish a database of this information when possible. Otherwise, establish a data inventory plan that identifies and catalogues historical data not suited for database entry

To facilitate information utilization and decisionmaking, a set of guidelines and specifications is presented for application development, personnel qualifications, guidelines for delivering data management services, and site characterization and remediation projects. Included in this DMP are the specifications for the environmental database software application (project database) that will be used by all contractors for Base operations. The project database to be used by the contractor will be briefly described in the project-specific Work Plan. Any project database deviations from the database specifications presented in this DMP will be

stated in the project-specific Work Plan. The following specifications are provided to ensure compatibility of the project database with the ERPIMS database and with Base and AFCEE requirements. These specifications include the routines, processes, and guidelines for sample tracking, storage, access, delivery, and reporting of chemical analytical, geologic, and spatial data generated during site characterization, remedial investigation, and remedial action activities on the Base.

Certain historical and field data may not be suited for processing by the same environmental database application, depending on the nature of the data. Special databases will then be developed or adapted for historical data in project directories and will be catalogued for recordkeeping and ease of access.

This DMP also addresses cataloging, distribution, and storage of offsite and onsite laboratory hard copy data, field data, and historical data.

The DMP processes supplement the Quality Assurance Project Plan (QAPP) for the Richards-Gebaur AFB IRP.

## **A1.2 Data Management Activities**

### **A1.2.1 New Data Management**

For new data being generated as part of field and laboratory operations, the data management system revolves around six somewhat overlapping phases of activity:

1. **Planning:** The approved sampling plan is used as the basis for incorporating sampling and analysis information into the sample tracking program (STP), which will be built into the project database.
2. **Fieldwork:** Field efforts are carried out according to information in the STP. A computerized STP is installed in the field and is continually updated to reflect real-time information. Field measurements are collected and catalogued for entry into the project database or the appropriate project file to facilitate report writing and generate Environmental Restoration Program Information Management System (ERPIMS) deliverables.
3. **Sample analysis:** Analyses are performed in accordance with the QAPP. Hard copy and/or electronic data are delivered to the data management team in the agreed-upon format.
4. **Data collection:** Hard copy and electronic data are entered into their respective physical and electronic placeholders, and are tracked, imported, and catalogued as appropriate.
5. **Database management and data validation:** The electronic data are checked for completeness and consistency with hard copy data reports. Semi-automated data validation occurs using hard copy and electronic data. All validation flags and findings will be stored in the project database, resulting in a relational database from sample tracking through validation.
6. **Data reduction:** ERPIMS files, summary statistics, plots, program-specific interface files, and reports are generated.

### A1.2.2 Historical Data Management

Some projects might incorporate historical environmental data that have been gathered by various contractors from previous investigations. Managing historical data is complicated by the fact that contractors often have unique data sampling, analysis, and management procedures. The variety of historical data sources and formats, including ecological reports, field data, analytical data, and GIS data, must be addressed.

Historical data sources could include ERPIMS, RI reports, ecological reports, or contractor databases. Depending on their procedures, various environmental contractors might upload field data into ERPIMS differently. Therefore, ERPIMS data might be either raw or validated. Similarly, contractor environmental databases could contain both raw and validated data. Only data that have been presented in Air Force-approved reports (approved documents), such as RI reports, are assumed to have been validated.

To manage historical data in a manner that addresses the variety of sources and formats, along with concerns regarding data validation, the following procedures will be implemented:

1. Electronic data submitted to support data from approved documents on original data collection forms, logs, or laboratory reporting sheets will be checked against the appropriate written report to ensure its accuracy
2. When data gaps occur, the data manager will make the data set as complete as possible by consulting the appropriate approved documents or completed laboratory reporting sheets, or through direct communication with the appropriate environmental contractor or laboratory staff. To the greatest possible extent, data will not be entered without a reliable source.
3. After data entry, the data will be assigned a QC level for the data users that corresponds to the level of quality or validation that the data received from known, reliable sources. The QC levels are:
  - Fully validated and qualified
  - Not validated or qualified
4. Program code (i.e., table constraints, database triggers, and stored packages of procedures and functions) will be built into the project database to regulate data input and flag data that do not conform to established criteria for completeness, consistency, and uniformity. These data will be identified, corrected, and re-entered.
5. To verify that input regulation is effective, a minimum of 10 percent of the data that have passed these procedures will be randomly selected and checked against source documents. When a data set successfully completes this process, the status flags for the data set will be toggled for viewing by the data users.
6. User-requested changes to these data will be made, as appropriate, by the data manager.

### A1.2.3 Database Administration

The primary functions of the project data coordinator will be to design, develop, and maintain the project database and back up the data. Database design and development will focus on providing rapid data entry and data retrieval, while promoting data integrity through various automated procedures. Database maintenance will consist of:

- Allocating system storage for the database
- Adding, altering, and deleting users, roles, and privileges
- Periodically defragmenting the database for more efficient operation
- Upgrading database software as necessary
- Providing for routine backup of the database to tape storage
- Maintaining an approved list of valid values for data consistency
- Maintaining redundancy control to ensure that each data record is unique and consistent with conventions
- Performing routine virus checks on incoming and outgoing data

#### **A1.2.4 GIS Integration**

Data that can be located on a map is said to have a geographic or spacial reference. GIS software is designed to efficiently manage this kind of information. A GIS provides software applications designed specifically for storing, managing, manipulating, analyzing, and displaying spatially related data. Integrated with other software applications, such as models and facility information management software, a GIS is unparalleled in its ability to support detailed data analysis, decisionmaking, and information display.

The project database will be formatted to provide the capability to generate summary statistics by site, location, and matrix. Wherever possible, the data should be in a format compatible for GIS upload and use

GIS capabilities enhance the following functions:

- Decisionmaking
- Providing easy data access to a variety of end users
- Developing models
- Making predictions about the behavior of contaminant plumes and other environmental variables
- Performing spacial, statistical, and measurement operations and related analyses
- Generating reports
- Operating graphical display, including three-dimensional display
- Designing and planning ecological activities
- Tracking environmental compliance and monitoring

#### **A1.2.5 ERPIMS IRPTools/PC Submittal**

IRP data will be submitted to the Human Systems Division (HSD) of the Air Force in an electronic format compatible with the latest version of ERPIMS. The ERPIMS IRPTools/PC software program will be used to generate ERPIMS submittals from data in the project database. ERPIMS is a relational database maintained by HSD to store, analyze, and report information used for the Air Force IRP. The reporting requirements and file specifications are detailed in the *ERPIMS Data Loading Handbook* (Handbook).

The project database will contain modules and queries that prepare American Standard Code for Information Interchange (ASCII) files in the correct format for import into ERPIMS via IRPTools/PC from the same data that is used for RI/FS activities. All data delivered to HSD will be consistent with the ERPIMS reporting formats and valid values lists. Analytical data used to generate ERPIMS files are exactly as delivered from the laboratories, as required by ERPIMS. Validated data are not used in ERPIMS, in accordance with ERPIMS guidelines.

## **A1.3 Database Management System**

The following sections identify the required project databases and their relationships to each other. In addition, it includes discussion of the procedures and tools that maintain data integrity and security through automation of repetitive tasks, data verification through valid values and redundancy control, security and controlled access to the stored data, and file backup.

### **A1.3.1 Project Database Requirements**

The project database will be a relational database system that stores information in a series of data tables. Relational database systems are designed so that each piece of information is stored only once. Data tables can then be linked so that duplication of fields in multiple tables is avoided. This architecture saves storage space in the computer, eliminates the need to update the same information in more than one location in the database, speeds up data manipulation for large data files, and avoids potential errors created by updating the same information more than once.

The project database will allow the database user to save a menu of standard queries, forms, and reports that will potentially be repeated many times, as the data contained in the database are updated. Queries are developed by the database operator using a graphical user interface provided by the project database. Requested information is output into user-defined reports and forms, and is available for manipulation, interpretation, or export to other data interpretation tools. The project database should support a number of transfer formats, such as ASCII text files, Microsoft Excel, Lotus 1-2-3, Symphony, rich-text format (.RTF) files for Microsoft Word, and other Windows word processing packages, such as Btrieve, Paradox, and dBase formats.

It is essential for the project database to provide features to enhance data management, such as the following:

- Generation of sample bottle labels, Chain of Custody (CoC) forms, and daily field instruction reports
- Automated electronic loading of laboratory analytical results
- Semi-automated hand entry of analytical results when data are not electronically available
- Built-in QA/QC routines to protect against data redundancy and errors
- Routines that electronically compare results to project-specific reference or screening criteria
- Standard but flexible reporting and delivery formats from a single database source in support of data analysis, site characterization, and risk assessment

- Export data to or link directly with a variety of GIS or data visualization packages
- Semi-automated data validation using electronic data loaded from offsite and onsite laboratories; this feature facilitates the dissemination of validated data in a timely fashion

Data storage in the project database facilitates generation of ERPIMS files and interfacing with the ERPIMS Contractor Data Loading Tool to prepare ASCII files in the correct format.

A suggested database structure is described below. It is not mandatory that project databases adhere to this structure, but this example structure is described to suggest how an efficient, automated, relational environmental database can be constructed.

The project database described here consists of four linked database modules. Each module focuses on a different activity in the data life cycle and is Menu- and Form-driven for ease of use. The four linked database modules are:

1. **Field Data:** This module contains all required information and programming to print daily field work sheets, container labels, CoC forms, and to track any deviations in sampling from the approved SAP. This module performs most of the STP field functions. All pertinent information from the SAP is loaded into the Field Data module as a series of tables and is linked to all other modules for later processing. The main data tables would contain all pertinent SAP information and all pertinent real-time CoC information.
2. **Analytical Data:** This module contains all required programming to load laboratory data both automatically through laboratory electronic data (EDATA) or manually for certain field laboratory data; verify data completeness and agreement with the data in the Field Data module; provide quality control for valid values; and is the ultimate repository for all validated data. In addition, this module tracks turnaround times, data validation status, simulated invoicing based on contract pricing, and receivable inventories. The main tables would include all analytical data as they arrive from the laboratories, all validation information generated from a validation module (see [3.] below), and all pertinent information for submittals. With linkage to a Field Data Module, these three tables contain the information necessary to do data calculations, generate statistical summaries, generate many of the ERPIMS tables, and provide for Informal Technical Information Report (ITIR) generation and QC summary reports.
3. **Data Quality Evaluation:** This module can include a series of forms that assist in semi-automated data validation. The validation information includes the data validation flags, an explanation of each flag, and a final flag that is the most severe flag. The main tables, are a "Report" table, which includes all explanatory text that is necessary for generating validation reports, and a number of look-up tables that contain project-specific QC acceptance criteria to compare actual QC performance to acceptance criteria. The data validator can be prompted to review exceedances, and if the data validator agrees with the module's conclusions, then validation flags are automatically added to the validation tables in the Analytical Data module through forms and query.

The validation reports are automatically printed at the conclusion of each validation session that summarizes the validation conclusion (report generated by sample delivery group). The validation reports include statistical summaries of flags and flagging reasons using the information in the Analytical Data module validation tables.

4. **Report Generator:** This module contains all programming routines, forms, and reports necessary for generating project-specific reports and is linked to the tables in the other three modules. This module is used for ERPIMS generation, ITIR and data summary

reports, and data calculations and reports. The main tables in this module, other than the linked tables, can include, as applicable, those needed for risk calculations and comparisons to trigger levels. In addition, this module contains routines and reports to generate boring logs electronically, based on data input from ERPIMS files.

### **A1.3.2 Automation**

As described above, nearly all operations are either completely automated, or semi-automated. The use of automated routines that have been quality controlled speeds up data entry or processing and improves data consistency and quality. Automation includes the use of proven queries, forms, reports, and statistical modules for the entry of manual data, quality control of electronic data, and generation of export files or reports.

#### **Streamlined Manual Entry**

Manual entry is usually reserved for data such as field screening analytical data, field lithological data, some offsite laboratory data for bioassessment, and corrections to electronic data that are better served by modifying already imported data sets as opposed to deleting and re-importing entire data files. Manual entry can be facilitated by project database data entry forms that allow only the entry of valid values and can allow two separate technicians to enter the same data and compare the two for accuracy. Prompts and menus would facilitate this process.

#### **Electronic Input**

All electronic input of laboratory data can be accomplished in the Analytical Data module through menus and forms that perform various quality control routines. The QC routines include, but are not limited to, routines that compare the received data to the data requested in the Field Data module; check valid values or update lab-specific values to valid values; record receipt and prepare draft invoices; and calculate turnaround times for contract compliance. The data format and content requested from the laboratories include all necessary information for risk assessment, data validation, and the generation of Group 3 ERPIMS files. AFCEE projects have unique requirements because of the subtle but critical differences in the requirements of the AFCEE Model QAPP and ERPIMS.

All electronic data will have field names in the first row of the comma-delimited ASCII files, and valid values for the fields listed above are provided by the project data manager.

### **A1.3.3 Data Verification**

#### **Valid Values**

Valid values are critical to any large relational database. Inconsistencies in naming conventions, subtle analyte or method spelling differences, and the use of non-standard abbreviations can result in lost data and incorrect conclusions. Most tables and forms in the four project database modules or in any environmental database can use look-up tables for acceptable valid values and will not allow the entry of data that does not conform. Valid value look-up tables are an essential component of ERPIMS generation and originate in the project database.

#### **Redundancy Control**

A primary purpose of managing data in the database environment is to ensure that each data record is unique and that the information contained within each field is consistent with



conventions defined in other areas of the database. To ensure uniqueness, a key field or fields will be identified for each data record. Key fields define the record as unique.

To maintain consistency with naming conventions used in a database, the project database should allow the establishment of parent-child relationships between database files. These relationships can be facilitated by configuring database tables to "look up" to the proper parent table. Strategies for enforcing parent-child relationships are different for electronic versus manual data entry.

Each set of key data has a placeholder established, usually from the SAP or QAPP data tables for sample-analyses combinations and for QC criteria, for example. As data are entered, the placeholder is toggled and no further entries are possible without user intervention.

Electronic data entry into the database will require that all parent-child relationships be verified following the data input process. For manual data entry, forms and tables utilize a feature that allows only valid entries into a database, including fields that can look up to other fields in a parent table and fields that can be set up to default for a specific value or only accept certain alphanumeric characters. The follow-up integrity checks are minimized with these fields constrained.

The key tables could be located in the modules described above. No duplication of tables is required and all tables used between modules are "attached." That is, the tables reside in one place, but may be accessed by other modules for use in their respective processes. This allows for the segregation of processes without the need for multiple copies of data and redundancy and version control problems.

Table A1-1 provides a sample format for laboratory electronic data.

### A1.3.4 Security and Access

#### Log In

All data modules (except for the Field Data module during the field event) are stored on a secured section of the local area network (LAN) established for a project, with access restricted to those in the data management project team. Each module has the capability of password and capability restrictions that are applied as the project progresses and the team members are finalized. Access to select portions of the database is automatically recorded with name, date, and time. In addition, key forms and processes can have automatic access recording for data entry and changes.

**TABLE A1-1**  
Sample Format for Laboratory Electronic Data

Field	Type/Length	Description/Comments
LabName	C10	Name of laboratory performing the work Used to distinguish among different laboratories.
SDG	C8	Sample delivery group designation Always populated for all samples, including QC
FieldID	C13	Client sample ID as it appears on the CoC with optional laboratory-assigned suffixes and/or prefixes to make it unique
NativeID	C13	Client sample ID, exactly as it appears on the CoC No prefix or suffix allowed. Used to identify native sample from which other samples are derived (e g., QAQCType = "LR", "MS", or "SD").

**TABLE A1-Continued**  
**Sample Format for Laboratory Electronic Data**

Field	Type/Length	Description/Comments
QAQCType	C2	"N," "LB," "EB," "FD," "MS," "SD," "TB," "FB," "BS," "BD," and "LR" Any field sample that is not used as a laboratory QC sample and is not otherwise marked on the CoC should have the designation of "N."  No suffix allowed Example of forbidden entries: N1, EB2, etc.
LRTYPE	C3	Type of laboratory replicate sample reported. Values are: blank (if QAQCType value is not "LR"), "DL" (dilution), "RE" (re-analysis), and "D" (inorganic duplicate). For multiple dilutions or re-analyses of the same sample, append the replicate number after the LRTYPE value (i.e., "RE", "RE2", "RE3", etc )
Matrix	C5	"AIR," "WATER," and "SOIL" are the only defaults if matrix is not clearly marked on the CoC. The use of "liquid," "solid," etc., for lab QC is not allowed
Lab SampleID	C20	Laboratory sample ID. Prefix or suffix is allowed. This is where dilutions or re-extractions are noted. Example. "D97-11111RE" is acceptable.
Analysis Method	C20	Analysis method name Example. SW8260A Cannot have generic names such as "EPA "
Extraction Method	C20	All extractables must have a method number Example: SW3550 If there is none, or it is part of the method, use "METHOD."
SampleDate	Date	Format mm/dd/yy.
ReceiveDate	Date	Format. mm/dd/yy.
ExtractDate	Date	Format mm/dd/yy.
ExtractTime	Time	24-hour format: hh mm
AnalysisDate	Date	Format: mm/dd/yy
AnalysisTime	Time	24-hour format: hh mm
PercentSolids	number	Percent solids within the sample. Should be zero for water samples
LabLotCtlNum	C10	Identifier linking QC samples with normal environmental samples Example extraction batch ID.
CAS	C20	CAS number of analyte.
ParamID	C12	ERPIMS Code for the analyte
Analyte	C40	Name of analyte, chemical name - not the ERPIMS field PARLABEL.
Result	C16	Numeric result (in text) of the analysis. Surrogate analytes will be reported in units of percent. All others will be reported in sample concentration units.
ExpectedValue	C16	"100" for surrogates, "0" (zero) for blanks, spike level plus parent result for laboratory control sample (LCS), and matrix spike/matrix spike duplicate (MS/MSD); parent value for lab duplicate, etc
Units	C10	Units of measure used in the analysis Report "PERCENT" for surrogate analytes and concentration units for all others
Dilution	number	Total dilution reported in the analysis. Default value should be 1 (one). This value should reflect changes to sample preparation amounts as defined by the method (e g., less sample used for standard volatile organic compound [VOC] analysis).

**TABLE A1-1**  
Sample Format for Laboratory Electronic Data

Field	Type/Length	Description/Comments
MDL	C16	Minimum detection limit adjusted for dilution and percent moisture.
RL	C16	Reporting limit adjusted for dilution and percent moisture Equivalent to practical quantitation limit (PQL)
LabQualifier	C10	Laboratory qualifier for the results, AFCEE QAPP Flags (Note Tentatively identified compounds [TICS] are identified here.)
Surrogate	C1	Is the chemical a surrogate? Report "Y" or "N"
Comments	C240	Comment field
ParValUncert	C16	Radiological parameter value uncertainty
Recovery	number	Percent recovery for MS, SD, LCS, and surrogate compounds.

## Virus Checking

All files received from subcontractors will be scanned for common viruses using standard, current virus protection programs.

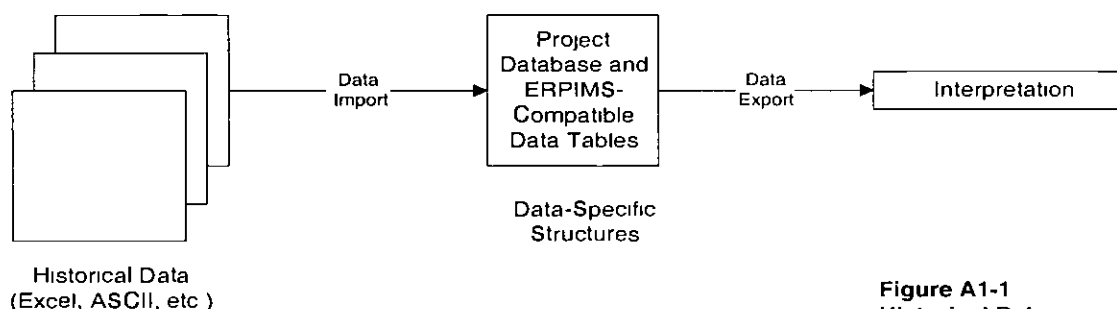
## A1.3.5 File Backup

All project database files should be backed up daily. These backup files should be saved for up to 6 months. Weekly backups will be kept for a minimum of 10 years. Main project files will be backed up on a secure location and medium monthly.

## A1.4 Data Flow

### A1.4.1 Historical Data

Required historical data will be added to the new data tables constructed in the project database, where appropriate. In some instances, these data will not be the type or format for input into the project database system and will have their own unique structures. The historical data process is shown on Figure A1-1.

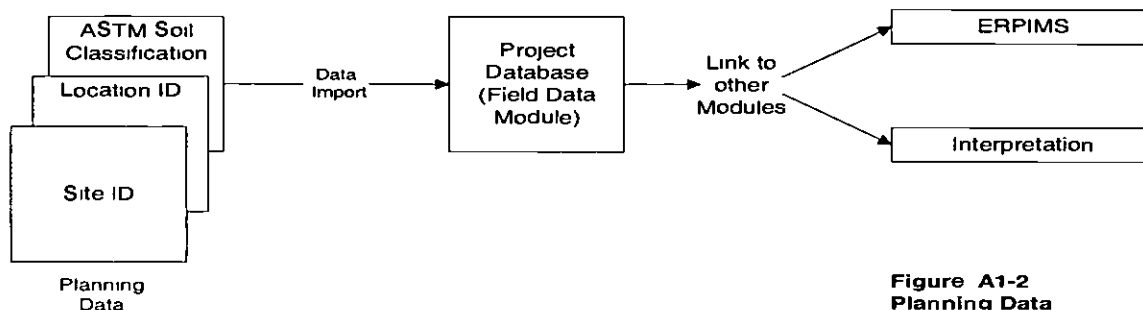


**Figure A1-1**  
Historical Data

Data that are not suited for database entry will be stored and cataloged in the most appropriate manner to be determined for each data type. All data in electronic format, or that can be easily put into electronic files, will be stored electronically in a secure data storage area designated for each project.

### A1.4.2 Planning Data

Planning data are generated during preparation of the Work Plan. Types of Planning data that include site identification, location identification, and hydrogeologic classification are used primarily for sample identification and ERPIMS submittals. Site and location information is included on sample labels and CoC forms and is processed through the project database Field Data module or equivalent. Site and location conventions will be defined according to the Base's expectations and in consultation with ERPIMS. The planning data process is shown on Figure A1-2.

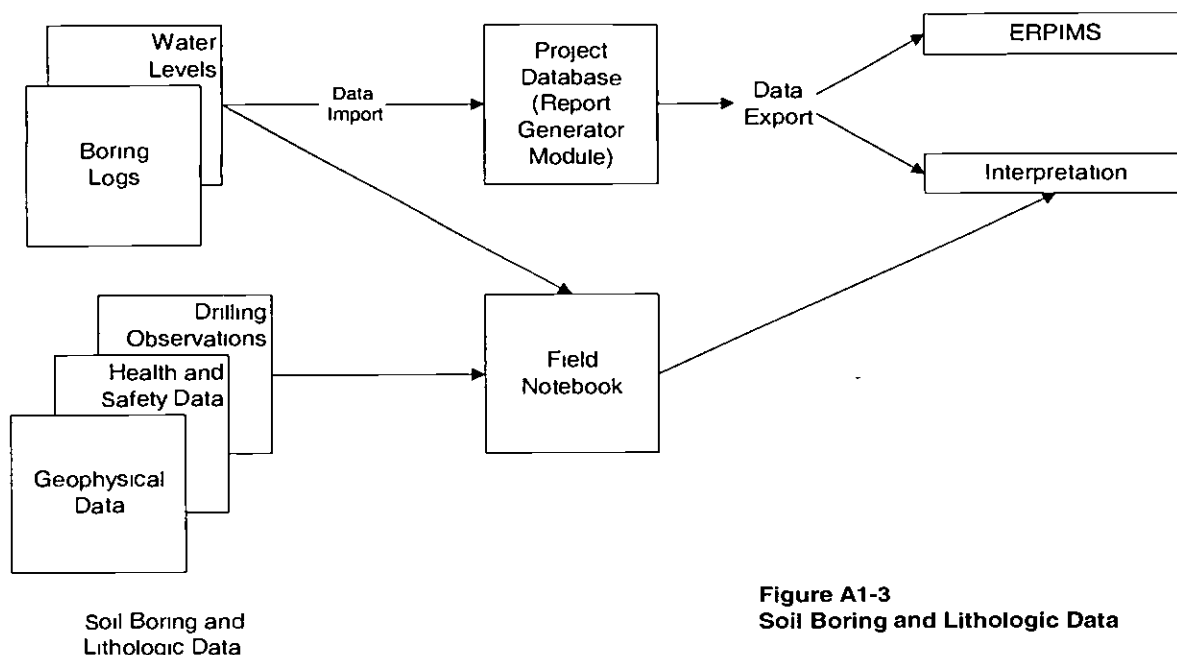


**Figure A1-2**  
**Planning Data**

### A1.4.3 Soil Boring and Lithologic Data

All of the information collected during the drilling of borings for well or piezometer installation is recorded on soil boring log forms and in field notebooks.

The information recorded manually on the soil boring log form includes: drilling contractor and equipment used, surface elevation and State Plane coordinates of the boring location, start and finish dates for the boring, the personnel responsible for logging the lithology, the groundwater elevation if encountered, the lithologic description and ASTM classification codes of soil samples collected during drilling, and organic vapor monitor (OVM) readings. The soil boring and lithologic data process is shown on Figure A1-3.

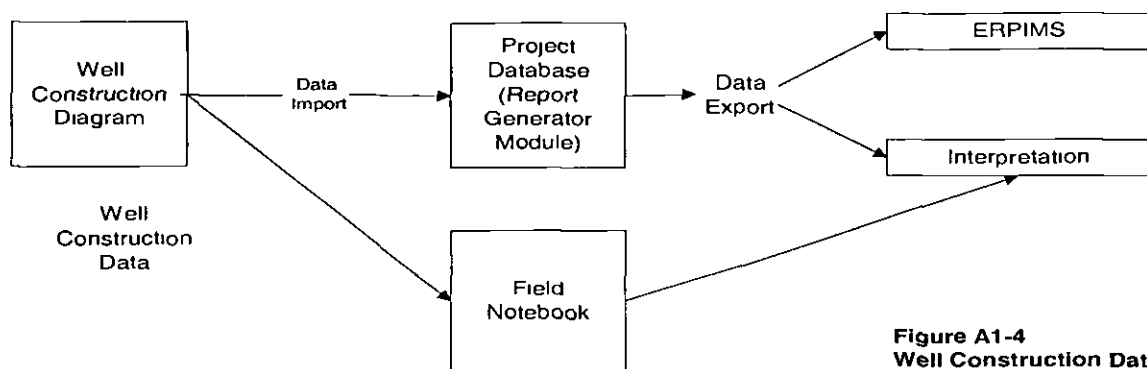


**Figure A1-3**  
**Soil Boring and Lithologic Data**

The ultimate disposition of these data, once they are transmitted back to the office, depends on the data type. The field notebooks, boring log forms, and geophysical logs will be organized into project notebooks and archived in the project files. However, certain types of information will also be extracted and manually entered into the project database for use in ERPIMS and other export files.

#### A1.4.4 Well Construction Data

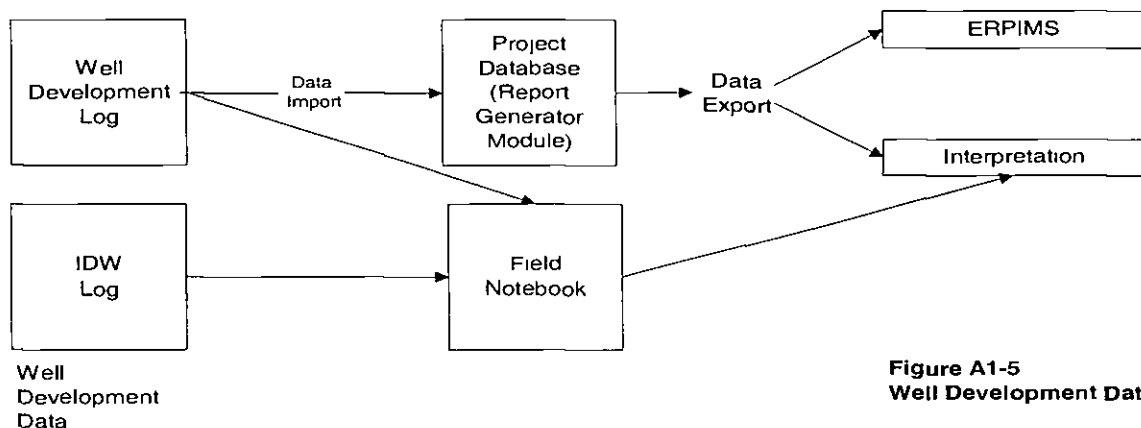
The data collected during well construction include the physical aspects of the well or the piezometer being constructed. Much of these data are included in the final ERPIMS submittal. This includes the depths of the screen interval, filter pack and sanitary seal, casing and well screen diameter and type, gradation of the filter pack used, and grout mixture used to install the sanitary seal and other parameters. Additional information recorded during well construction includes borehole diameter, information on backfill material used, specifications of any conductor casing installed, and a description of the surface completion of the well. This information is recorded on a well construction log or diagram completed at the time of well construction. The well construction logs are organized into project notebooks and archived in the project files. The well construction data process is shown on Figure A1-4.



**Figure A1-4**  
**Well Construction Data**

### A1.4.5 Well Development Data

The type of information that is collected during development includes the location in the well screen where surging is performed and the duration of surging, flow rate and duration of development pumping stages, static groundwater elevations in the well and water levels during development pumping, observations made during bailing of sediments from the well or during development pumping, and water quality measurements made on the development water throughout the development process. The water quality parameters measured during development include pH, electrical conductivity (EC), turbidity, dissolved oxygen (DO), and temperature. The information collected during development will be recorded in an Excel well development spreadsheet. The electronic files will be imported into the database.



**Figure A1-5**  
**Well Development Data**

The well development data process is shown on Figure A1-5.

### A1.4.6 Sampling Data

All samples collected in the field and submitted to a laboratory for analysis must be accompanied by a CoC form. The information included on the CoC form will include project name and number, station ID, date and time of sample collection, sample collection method, sample description, number of sample containers, the analyses requested, the date requested for completion of the analysis, the names of personnel collecting the sample, the chain-of-transfers between subsequent personnel handling the sample before it arrived at

the lab, and the date and time of any transfers. Most of this information will be automatically included on the CoC form (using the Field Data module, or equivalent, if one is included in the project database) and the tables therein that are populated with information derived from the approved SAP. The sampling data process is shown on Figure A1-6.

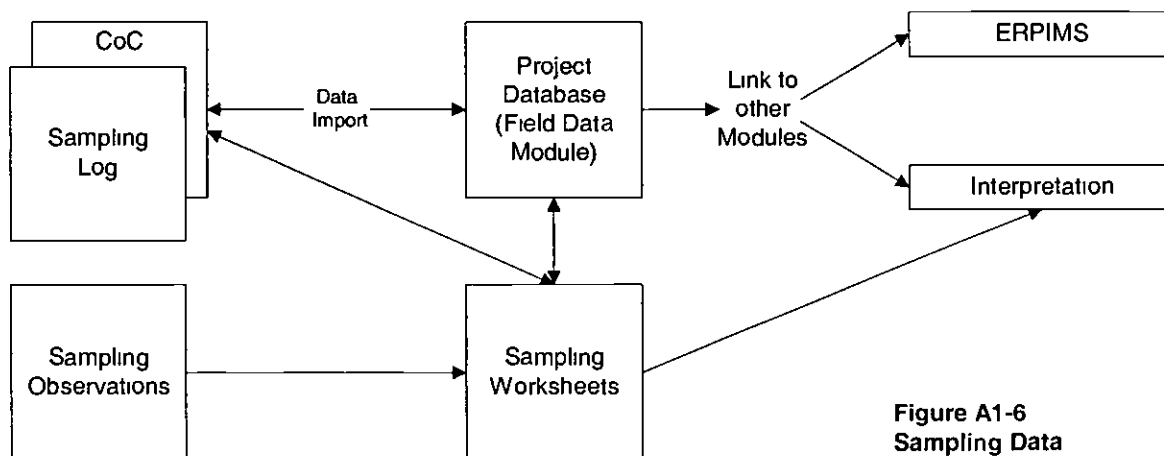


Figure A1-6  
Sampling Data

The information that will be added into the Field Data module database during sampling would include the actual date and time of sample collection, depth of sample collection, sampler initials, and miscellaneous comments.

#### A1.4.7 Analytical Data

Most analytical data will be imported electronically (in the Analytical Data module, if one is included in the project database) as described above. The CoC information (from the Field Data module if included) will be downloaded periodically to the project LAN. These data will be used to track project progress, turnaround time compliance, and validation scheduling. The analytical data process is shown on Figure A1-7.

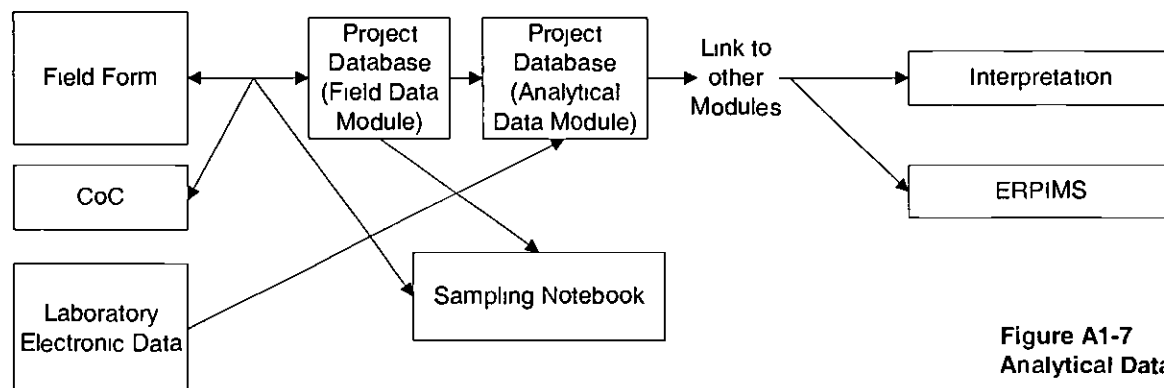


Figure A1-7  
Analytical Data

#### A1.4.8 Analytical Timeliness

The use of the Analytical Data and Data Quality Evaluation modules allows for the loading and validation of data in a real-time mode. As data are received from the laboratories,

loading into an Analytical Data module verifies the completeness of the data vis-a-vis the analyses requested in the Field Data module. In addition, Analytical Data module programming tracks expected delivery dates and notifies the database manager of data that are past their due date. This starts the process of notifying the laboratories and the project team. The project database or its Data Quality Evaluation module can be designed so that the data quality evaluation process occurs as each set of data is received from the laboratories. This allows for rapid dissemination of validated data to the data users for decisionmaking and "course corrections" in the field, when appropriate. In addition, the rapid data quality assessment allows for modifications of laboratory practices or additional audits to correct analytical problems in time to minimize the effect on the remainder of the project. Throughout the project, validated data, validation reports, and data summaries are constantly made available to the project team.

#### **A1.4.9 Mobile Lab (when applicable)**

##### **Electronic Data**

Whenever possible, all mobile laboratory data will be generated in an electronic format similar, if not identical, to that for the fixed laboratories. This will allow for the timely and efficient incorporation of data into the project database. When data are unavailable electronically, the use of data entry forms will facilitate the entry and quality control of manually entered data.

##### **Documents**

Documentation of mobile laboratory data will be negotiated with each laboratory. Unlike the fixed laboratories that have the capability to supply data in the format expected by AFCEE, this screening data might be captured in a different hard copy format. The pertinent QC information will be prescribed by the project-specific QAPP and supporting documentation. All mobile laboratory data will be stored and catalogued in the same manner as the fixed laboratory data.

#### **A1.4.10 Additional Field Data**

Some field data will be kept in the field project files and not necessarily cataloged or controlled by the data management system

### **A1.5 Data Analysis**

#### **A1.5.1 Standardizing the Analytical Results**

Data Standardization involves identifying and standardizing all units associated with each analytical method. Units might be user-specified depending on cleanup criteria comparison or preference. The project database will identify all versions of units within each matrix and analytical method and will convert units to the project-specific units. All reporting and output is generated from the project database or its Report Generator module, if included in the database, in constant units using look-up tables where necessary.

#### **A1.5.2 Data Exporting and Report Generation**

When the project database is constructed to include linked modules, the Report Generator module is the module most often used for the following functions:

- Exporting electronic data



- Generating statistical results
- Generating Data Visualization or GIS export files
- Generating data tables for evaluation and presentation
- Generating ERPIMS export files

## **A1.6 Project Closeout**

### **A1.6.1 Final Backup**

Upon completion of the project, the project database modules are backed up onto compact disk and stored both on and offsite.

Laboratory electronic deliverable diskettes or electronic mail files are logged into a project-specific CD and stored with the project database modules.

Original hard copy data reports are logged into the project file and assigned a unique filing ID for easy retrieval. Upon project closeout, the data packages will be archived with the project files.

### **A1.6.2 Data Deliverables**

In addition to the ERPIMS submittals, data will be supplied to the project team to collect, prepare, publish, and distribute data designated on the AFCEE Contract Data Requirements List (CDRL).

**Attachment 2**  
**Quality Control Criteria and Quantitation Limits**

## Attachment 2

Table 1

Quality Control Acceptance Criteria for Radiological Methods  
CH2M HILL/RGAFB QAPP

RL - Water			
E901 1 - Gamma emitting nuclides = 25 pCi/L E900 0 - Gross alpha/beta = 4.0 pCi/L			
RL - Soil/Sediment			
E901 1 - Gamma emitting nuclides 25 pCi/g E900 0 - Gross alpha/beta = 4.0 pCi/g			
QC Check	Minimum Frequency <sup>a</sup>	Acceptance Criteria <sup>a</sup>	Corrective Action <sup>a,c</sup>
E901.1 Gross Gamma			
Geometry specific calibration checks- efficiency calibration checks	Minimum of 10% of field samples	Within 15% +/- counting error of expected value or within historical laboratory derived limits	Recount and recalibrate
Detector calibration checks Energy, efficiency and resolution	Daily	Within +/- 3 sigma of historical mean	1) Replicant recounts 2) Service instrument
Sample Duplicate	Minimum of 10% of samples	Relative error ratio < 1.0	Chemist will evaluate the data for potential cause of variability and notify data users
Detector background	Daily	Within +/- 3 sigma of historical mean	1) Clean detector and shield 2) Recount background
E900.0 Gross Alpha/Beta			
Instrument performance checks	Once daily	Within +/- 3 sigma of historical mean	Recalibrate
ICV and CCV	Once daily	Recovery 85-115% +/- counting error	Evaluate possible source of variability, Repeat measurement
LCS (water samples only), ICV, CCV	One LCS per analytical batch	Recovery 85-115% +/- counting error	Evaluate possible source of variability, Repeat measurement
Method Blank	One per analytical batch	Results- counting error < RL	If sample results are > 10 times the MB then flag the data, If sample results are < 10 times MB results then re-analyze/re-extract
Cross-talk Standard check	Every calibration	Within manufacturers specifications	Adjust HV or discriminator controls, then recalibrate and measure blank
Calibration Verification Standard (Soils only)	Minimum of 10% of samples	Recovery 75-125% +/- counting error	Evaluate possible source of variability, Repeat measurement
Flagging Criteria <sup>b,c</sup>			
Apply R to all results for specific analyte(s) for all samples associated with the calibration			Apply R to all results for specific analyte(s) for all samples associated with the calibration
Apply R to all results for specific analyte(s) for all samples associated with the calibration			Apply R to all results for specific analyte(s) for all samples associated with the calibration
J flag target hits > RL, UJ flag non-detects			Apply R to all results for all samples analyzed by the analyst

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

<sup>c</sup> These criteria are laboratory-specific and when additional laboratories are identified, these criteria will be updated at the level of effort listed above

Attachment 2

Table 2

QC Acceptance Criteria for Method SW9030 — Sulfide  
CH2M HILL/RGAFB QAPP

RL - Water = 2.0 mg/L Accuracy Water (% R) = 75-125 Precision Water (RPD) = ±25	RL - Soil = 20 mg/Kg Accuracy Soil (% R) = 75-125 Precision Water (RPD) = ±25
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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Titrant standardization	Daily (prior to sample analysis)	None	None	None
Initial calibration verification (ICV)	After standardization and before sample analysis	Analyzed result within 90-110% of the true value concentration ±	Correct problem then repeat standardization	Apply R to all results for specific analyte(s) for all samples associated with the standardization
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria.	Apply R to all results for all samples analyzed by the analyst
Method blank	One per analytical batch	No Sulfide detected > RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
LCS for Sulfide	One LCS per analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 3

Quality Control Acceptance Criteria for EPA Draft Method (April 1991) Acid-Volatile Sulfides (AVS)

CH2M HILL/RGAFB QAPP

<b>RLs - Soil/Sediment</b> Acid Volatile Sulfides = 25 mg/Kg Cadmium = 0.5 mg/Kg Copper = 5.0 mg/Kg Mercury = 0.04 mg/Kg Lead = 5.0 mg/Kg Nickel = 4.0 mg/Kg Zinc = 2.0 mg/Kg Accuracy Water (% R) = 75-125 Precision Water (RPD) = ±25
--

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Five-point initial calibration	Daily	Coefficient of correlation Greater than or equal to 0.995	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification	After initial calibration and before sample analysis 1 in 10 analytical samples	Analyzed result within 90-110% of the true value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method blank	One per analytical batch	No targets detected > RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
LCS	One LCS per analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > UCL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

- <sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory
- <sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed
- Simultaneously extracted metals acceptance criteria is defined for the appropriate analytical method in the AFCEE QAPP version 2.0

## Attachment 2

Table 4

Quality Control Acceptance Criteria for Method 1664 — Oil and Grease  
CH2M HILL/RGAFB QAPP

RL - Water = 5 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Two-point initial calibration of analytical balance	Daily Initial calibration prior to sample measurements	+/- 10% of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification	Before and after sample measurements are taken	+/- 10% of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method blank	One per analytical batch or 10 % frequency whichever is greater	Not measured > RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
LCS	One per analytical batch or 10 % frequency whichever is greater	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detected
MS/MSD	One MS/MSD per every 10 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 5

Quality Control Acceptance Criteria for Method E130.2 — Total Hardness  
CH2M HILL/RGA/FB QAPP

RL - Water = 10 mg/L  
Accuracy Water (% R) = 75 - 125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Titrant standardization	Daily (prior to sample analysis)	None	None	None
Initial calibration verification	After standardization and before sample analysis	Analyzed result within 90-110% of the true value concentration $\pm$	Correct problem then repeat standardization	Apply R to all results for specific analyte(s) for all samples associated with the standardization
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method Blank	One per preparation and analytical batch	<RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Laboratory Control Sample (LCS)	One per preparation and analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) MSD > 100% of RL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte(s) in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 6

Quality Control Acceptance Criteria for Method E350 — Nitrogen, Ammonia  
(E350 1, E350 2, E350 3)  
CH2M HILLURGAFB QAPP

RL - Water = 0.3 mg/L Accuracy Water (% R) = 75-125 Precision Water (RPD) = ±25		RL - Soil = 15 mg/Kg Accuracy Soil (% R) = 75-125 Precision Soil (RPD) = ±25	
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>
Initial Calibration (4 standards and a blank)	Daily before analysis	r > 0.995 Calibration MUST meet acceptance criteria prior to sample analysis.	Identify and repeat outlying point(s), recalculate curve using repeated point(s)
Initial calibration verification (ICV) and continuing calibration verification (ccv)	Daily before first batch is analyzed	Response within ±15%	1) Repeat continuing calibration verification (ccv) 2) If still out, identify and correct problem 3) Recalibrate and reanalyze all samples analyzed since last valid CCV
Method blank	1 per preparation batch and analytical batch	< RL	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re-extract/analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision
Laboratory control sample (LCS)	1 per preparation batch and analytical batch	75-125 % recovery	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item 1), re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling.
Matrix spike/matrix spike duplicate (MS/MSD)	5% for each matrix	75-125 % recovery and RPD <25%	For the specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Equipment blank	10% per site per matrix	< RL	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > UCL
Temperature blank	Every cooler	4°C ± 2°C	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD - 50%	Apply B to all results for the specific analyte in all samples in the associated analytical batch

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
<sup>b</sup> Flagger criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed  
<sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable



## Attachment 2

Table 7

Quality Control Acceptance Criteria for Method E353 --- Nitrogen, Nitrate-Nitrite  
CH2M HILL/RGA/FB QAPP

Water (RL) = 0.1 mg/L Accuracy Water (% R) = 75-125 Precision Water (RPD) = $\pm 25$				
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Initial Calibration (4 standards and a blank)	Daily, prior to sample analysis	Correlation coefficient ( $r$ ) > 0.995  Calibration MUST meet acceptance criteria prior to sample analysis	1) Repeat outlying points  2) Recalculate curve using valid points  3) If still out, correct problem and recalibrate	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Initial calibration verification (ICV) Continuing calibration verification (CCV)	Once per multipoint calibration After every 10 samples	Within $\pm 15\%$ of expected value 85-115% recovery	1) Repeat ICV or CCV 2) If still out, identify and correct problem and repeat 3) If still out, repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Method blank	1 per preparation batch and per analytical batch	< RL	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re extract/re-analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS), Matrix spike/matrix spike duplicate (MS/MSD)	1 LCS per preparation and per analytical batch  1 MS/MSD 5% each matrix	75-125 % recovery and RPD < 25% and <30% for water and soil samples, respectively  75-125 % recovery and RPD < 25% and <30% for water and soil samples, respectively	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item 1), re extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling. If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Reduction check samples (same as LCS)	At start of analytical batch	NO3-N peak response must equal NO2-N peak response within $\pm 15\%$	Adjust hydriline concentration	Apply B to all results for the specific analyte in all samples in the associated analytical batch

**Table 7**  
Quality Control Acceptance Criteria for Method E353 — Nitrogen, Nitrate-Nitrite  
CH2M HILL/RGAFB QAPP

Water (RL) = 0.1 mg/L Accuracy Water (% R) = 75-125 Precision Water (RPD) = ±25				
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Temperature blank	Every cooler	4°C ± 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD < 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed  
<sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

## Attachment 2

Table 8

Quality Control Acceptance Criteria for Method E300.0 — Anions  
(Sulfate, Phosphate, Nitrate/Nitrite, and Chloride)  
CH2M HILL/RGAFB QAPP

**RLs - Water**  
Sulfate = 1.0 mg/L  
Phosphate = 0.5 mg/L  
Nitrate/Nitrite = 0.1 mg/L  
Chloride = 1.0 mg/L  
**Accuracy Water (% R) = 75-125**  
**Precision Water (RPD) = ±25**

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Initial calibration (4 standards and a blank)	Prior to sample analysis	Correlation coefficient ( <i>r</i> ) > 0.995  Calibration MUST meet acceptance criteria prior to sample analysis	1) Repeat outlying points 2) Recalculate curve using valid points 3) If still out, correct problem and recalibrate	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Initial calibration verification	After initial calibration and before sample analysis	Result within 90 - 110% of the true value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification (CCV)	Every 10 samples	± 15 % true value	1) Reanalyze CCV 2) If still out, identify and correct problem 3) Recalibrate and reanalyze CCV and all affected samples	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Method blank	1 per analytical batch and per preparation batch	All analytes < RL (Practical Quantitation Limits) <sup>c</sup>	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re-extract/re-analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS)	1 LCS per preparation batch and per analytical batch	75-125% recovery	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item 1), re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-defects

**Table 8**  
Quality Control Acceptance Criteria for Method E300.0 — Anions  
(Sulfate, Phosphate, Nitrate/Nitrite, and Chloride)  
CH2M HILL/REGAFB QAPP

**RLs - Water**  
Sulfate = 1.0 mg/L  
Phosphate = 0.5 mg/L  
Nitrate/Nitrite = 0.1 mg/L  
Chloride = 1.0 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Matrix spike/ matrix spike duplicate (MS/MSD)	5 % for each matrix	75-125% recovery and RPD < 25%	If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > UCL
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination <sup>c</sup>	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Temperature blank	Every cooler	4°C $\pm$ 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD < 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

<sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

Attachment 2  
Table 9

Quality Control Acceptance Criteria for Method E365 — Phosphorous, All Forms  
(E365 1, E365 2, E365 3)  
CH2M HILL/RGAFB QAPP

RL- Water  
Phosphorous, All Forms = 0.10 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) = ±25

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action *	Flagging Criteria *
Initial calibration (4 standards and a blank)	Daily (prior to sample analysis)	Correlation coefficient ( $r$ ) > 0.995 Calibration MUST meet acceptance criteria prior to sample analysis	Identify and repeat outlying point(s), recalculate curve using repeated point(s)	Apply R to all results for specific analyte(s) for all samples associated with the calibration
ICV	Daily following initial calibration	+ 15% true value	1) Repeat ICV 2) If not compliant, evaluate system and correct problem 3) Repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification (CCV)	Daily, before sample analysis, after every 10 samples, and at the end of each batch	± 15% true value	1) Reanalyze CCV 2) If still out, identify and correct problem 3) Recalibrate and reanalyze all samples since last valid CCV	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Method blank	1 per analytical batch and per preparation batch	< RL	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re extract/re-analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS)	1 per preparation batch and analytical batch	75-125% recovery	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item 1), re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Matrix spike/matrix spike duplicate (MS/MSD)	5% for each matrix	75-125% recovery and RPD < 25%	If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > UCL

**Table 9**

Quality Control Acceptance Criteria for Method E365 — Phosphorous, All Forms  
(E365 1, E365 2, E365 3)  
CH2M HILL/RGAFB QAPP

RL- Water  
Phosphorous, All Forms = 0.10 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) = ±25

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample contamination <sup>c</sup>	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Temperature blank	Every cooler	4°C ± 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum: 10% of field samples	RPD < 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

- <sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed  
<sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

## Attachment 2

Table 10

Quality Control Acceptance Criteria for Method E375 — Sulfate  
(E375 1, E375 2, E375 3, E375 4)  
CH2M HILL/RGA/FB QAPP

RL - Water = 1.0 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Initial calibration (4 standards and a blank)	Daily (prior to sample analysis)	Correlation coefficient ( $r$ ) > 0.995 Calibration MUST meet acceptance criteria prior to sample analysis	Identify and repeat outlying point(s), recalculate curve using repeated point(s)	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Initial calibration verification	After initial calibration and before sample analysis	Result within 90 - 110% of the true value	Correct problem then repeat initial calibration	Apply R to all results for all samples associated with the calibration
Continuing calibration verification (CCV)	Every 10 samples	$\pm 20\%$ true value	1) Reanalyze CCV 2) If still out, identify problem 3) Recalibrate and reanalyze all samples since last valid CCV	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Method blank	1 per preparation batch and per analytical batch	< RL (Practical Quantitation Limits)	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re-extract/re analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS)	1 per preparation batch and per analytical batch	75-125% recovery	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Matrix spike/matrix spike duplicate (MS/MSD)	5% for each matrix	75-125% recovery and RPD < 25%	If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > UCL

**Table 10**  
Quality Control Acceptance Criteria for Method E375 — Sulfate  
(E375.1, E375.2, E375.3, E375.4)  
CH2M HILL/ARGAFB QAPP

RL - Water = 1.0 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination <sup>c</sup> .	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Temperature blank	Every cooler	4°C $\pm$ 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD ~ 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

- <sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed  
<sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable



## Attachment 2

Table 11

Quality Control/Acceptance Criteria for Method E325 — Chloride

(E325 1, E325 2, E325 3)

CH2M HILL/RGAFB QAPP

RL- Water = 10 mg/L Accuracy (%R) = 75-125 Precision Water (RPD) = ±25				
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Titrant standardization	Daily (prior to sample analysis)	None	None	None
Initial calibration verification (ICV)	After standardization and before sample analysis	Analyzed result within 90-110% of the true value concentration ±	Correct problem then repeat standardization	Apply R to all results for specific analyte(s) for all samples associated with the standardization
Method blank	1 per preparation batch and per analytical batch	< RL	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re-extract/re analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS)	1 per preparation batch and per analytical batch	75-125% recovery	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Matrix spike/matrix spike duplicate (MS/MSD)	5% for each matrix	75-125% recovery and RPD < 25%	If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > UCL
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination <sup>c</sup>	Apply B to all results for the specific analyte in all samples in the associated analytical batch

**Table 11**  
 Quality Control Acceptance Criteria for Method E325 — Chloride  
 (E325 1, E325 2, E325 3)  
 CH2M HILL/RGAFB QAPP

RL- Water = 10 mg/L Accuracy (%R) = 75-125 Precision Water (RPD) = ±25				
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Temperature blank	Every cooler	4°C ± 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD - 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

- <sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed  
<sup>c</sup> if equipment blank is submitted to the laboratory blind, the corrective action is not applicable

Attachment 2

Table 12

QC Acceptance Criteria for Method RSK-114/175 — Methane/Ethane/Ethene  
CH2M HILL/RGAFB QAPP

RL - Methane = 0.5 ug/L
RL - Ethane = 0.7 ug/L
RL - Ethene = 0.7 ug/L
Accuracy Water (% R) = 80 - 120
Precision Water (RPD) = ±20

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>a</sup>
Seven-point initial calibration for RSK-114/175	Initial calibration prior to sample analysis	Coefficient of correlation Greater than or equal to 0.995	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification	After initial calibration and before sample analysis	All analytes recovered within ± 20% of expected concentration	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method (purge) blank	One per analytical batch	No MEE detected > RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
LCS for MEE	One LCS per analytical batch	QC acceptance criteria 80-120% recovery	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to non-detects
Duplicate	One duplicate per analytical batch	QC acceptance criteria, Table	None	None
MDL study	Once per year	Detection limits established shall be < the RLs	None	None
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

RL footnote-RL depends on the volume of headspace generated RLs are typical estimates

## Attachment 2

Table 13

Quality Control Acceptance Criteria for Method E160.1 — Total Dissolved Solids  
CH2M HILL/ARGAFB QAPP

RL - Water = 20 mg/L Accuracy Water (% R) = 70 - 130 Precision Water (RPD) = ±30			
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>
Method Blank	One per preparation and analytical batch	<RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank
Laboratory Control Sample (LCS)	One per preparation and analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch
Duplicate	One per preparation and analytical batch	RPD < 30%	None
MDL study	Once per year	Deviation limits established shall be < the RLs in Table	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or CALCULATED MDL > CL
Results reported between MDL and RL	None	None	Apply R to all results for the specific analyte(s) in all samples analyzed Apply F to all results between MDL and RL

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 14

Quality Control Acceptance Criteria for Method E160.2 — Total Suspended Solids  
CH2M HILL/ARGAFB QAPP

RL - Water = 10 mg/L  
Accuracy Water (% R) = 70 - 130  
Precision Water (RPD) =  $\pm 30$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Method Blank	One per preparation and analytical batch	<RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Laboratory Control Sample (LCS)	One per preparation and analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Duplicate	One per preparation and analytical batch	RPD < 30%	None	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or LCL < MSD < UCL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte(s) in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 15

Quality Control Acceptance Criteria for Method E310.1 — Total Alkalinity  
CH2M HILL/RGA/FB/QAPP

RL - Water = 10 mg/L  
Accuracy Water (% R) = 75 - 125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Titrant standardization	Daily (prior to sample analysis)	None	None	None
Initial calibration verification (ICV)	After standardization and before sample analysis	Analyzed result within 90-110% of the true value concentration $\pm$	Correct problem then repeat standardization	Apply R to all results for specific analyte(s) for all samples associated with the standardization.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method Blank	One per preparation and analytical batch	<RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Laboratory Control Sample (LCS)	One per preparation and analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-defects
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or calculated RPD > RL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte(s) in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

Attachment 2

Table 16

Quality Control Acceptance Criteria for Method SW9060 (Modified)— Total Organic Carbon  
CH2M HILL/RGA/FB QAPP

RL - Water = 1.0 mg/L Accuracy Water (% R) = 80 - 120 Precision Water (RPD) = ±20	RL - Soil = 5.0 mg/Kg Accuracy Soil (% R) = 80 - 120 Precision Soil (RPD) = ±20
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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Initial Calibration - single or multi-point calibration depending on manufacturer's recommendation for instrumentation	Daily before analysis	For multi-point calibration curve, regression criteria of $r > 0.995$ MUST be met prior to sample analysis	For single point - repeat initial point calibration, identify and repeat outlying point(s), recalculate curve using repeated points	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Second source calibration verification (ICV)	Once per calibration After initial calibration and before sample analysis	Analyzed result within ±10% of the true value concentration For single point calibrations, ICV standard shall be at half the concentration of the initial calibration standard	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Initial Calibration Blank (ICB)	One per Initial calibration	<RL	Correct problem then reanalyze ICV and ICB in sequence	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Continuing calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	Response within ±10%	1) Repeat continuing calibration verification (CCV) 2) If still out, identify and correct problem 3) Recalibrate and reanalyze all samples	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing Calibration Blank	One per preparation and analytical batch	<RL	Correct problem then reanalyze CCV and CCB and all samples associated with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Laboratory Control Sample (LCS)	One per every 20 samples or analysis batch whichever is the more frequent	QC acceptance criteria, Table	Correct problem and reanalyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) %R for MS or MSD > UCL and (4) %R for MS or MSD < LCL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte(s) in all samples analyzed
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

Table 16  
Quality Control Acceptance Criteria for Method SWS060 (Modified)— Total Organic Carbon  
CH2M HILL/REGAFB QAPP

QC Check	Minimum Frequency	RL - Water = 1.0 mg/L	
		Acceptance Criteria	Corrective Action <sup>a</sup>
		Accuracy Water (% R) = 80 - 120 Precision Water (RPD) = ±20	RL - Soil = 5.0 mg/Kg Accuracy Soil (% R) = 80 - 120 Precision Soil (RPD) = ±20
		Acceptance Criteria	Flagging Criteria <sup>b</sup>

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed



## Attachment 2

Table 17

Quality Control Acceptance Criteria for Method SM3500-FE D — Ferrous Ion  
CH2M HILL/RGAFB QAPP

Water (RL) = 0.1 mg/L Accuracy Water (% R) = 75-125 Precision Water (% RPD) = ± 25				
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Initial Calibration (4 standards and a blank)	Daily, prior to sample analysis	Correlation coefficient (r) > 0.995  Calibration MUST meet acceptance criteria prior to sample analysis	1) Repeat outlying points 2) Recalculate curve using valid points 3) If still out, correct problem and recalibrate	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Initial calibration verification (ICV) Continuing calibration verification (CCV)	Once per multipoint calibration After every 10 samples	Within ± 15% of expected value 85-115% recovery	1) Repeat ICV or CCV 2) If still out, identify and correct problem and repeat 3) If still out, repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Method blank	1 per preparation batch and per analytical batch	< RL	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re extract/re-analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS), Matrix spike/matrix duplicate (MS/MSD)	1 LCS per preparation and per analytical batch	75-125 % recovery and RPD < 25%	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item 1), re extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling. If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For specific analyte in all samples in the associated analytical batch, if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
	1 MS/MSD 5% each matrix	75-125 % recovery and RPD < 25%		
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination <sup>c</sup>	Apply B to all results for the specific analyte in all samples in the associated analytical batch

**Table 17**  
Quality Control Acceptance Criteria for Method SM3500-FE D — Ferrous Iron  
CH2M HILL/RGAFB QAPP

Water (RL) = 0.1 mg/L Accuracy Water (% R) = 75-125 Precision Water (% RPD) = ± 25				
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Temperature blank	Every cooler	4°C ± 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD < 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed  
<sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

## Attachment 2

Table 18

Quality Control Acceptance Criteria for Method OA-1/OA-2 (January 1990) Volatile and Extratable Petroleum Hydrocarbons  
CH2M HILL/URGAFB QAPP

RLs - Water, Soil/Sediment
TPH - Gasoline = 0.1 mg/L, 1.0 mg/Kg
TPH - Diesel = 1.0 mg/L, 10.0 mg/Kg

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action *	Flagging Criteria *
Five-point initial calibration	Initial Calibration prior to sample analysis	1 RSD $\leq$ 20% 2 Linear - least squares regression $r \geq 0.995$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification	Daily before sample analysis, and after every 10 samples	Analyzed result within $\pm 15\%$ of the true value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	Gasoline - Water = 67 - 136% Soil = 57 - 146% Diesel - Water = 61 - 143%	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method blank	One per analytical batch	No targets detected > RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
LCS	One LCS per analytical batch	Gasoline - Water = 67 - 136% Soil = 57 - 146% Diesel - Water = 61 - 143% Soil = 51 - 153%	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch, if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Surrogate Spike Gasoline - Chlorobenzene Diesel - Octacosane	Every sample, spiked sample, standard, and method blank	Gasoline - Water = 74 - 138% Soil = 64 - 148% Diesel - Water = 26 - 152% Soil = 25 - 162%	Correct problem then reprep and analyze sample	For samples, if the %R > UCL, apply J to all positive results. If the %R < LCL, apply J to all positive results, apply R to all non-detects. If %R < 10%, apply R to all results
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	Gasoline - Water = 67 - 136% Soil = 57 - 146% Diesel - Water = 61 - 143% Soil = 51 - 153%	None	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if, (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > UCL
Retention Time Window	Each Initial Calibration	As specified in SW-846 Method 8000B, Section 7.6	Correct problem then reanalyze all samples analyzed since last retention time check	Apply R to the result for Gasoline or Diesel in the sample
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

**Table 18**  
Quality Control Acceptance Criteria for Method OA-1/OA-2 (January 1990) Volatile and Extractable Petroleum Hydrocarbons  
CH2M HILL/REGAFB QAPP

RLs - Water, Soil/Sediment				
TPH - Gasoline = 0.1 mg/L, 1.0 mg/Kg TPH - Diesel = 1.0 mg/L, 10.0 mg/Kg				
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

**Attachment 3**  
**Laboratory EDD Format**

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**ATTACHMENT 3**  
**Laboratory EDD Format**  
**CH2M HILL/RGAFB QAPP**

**Electronic Data Deliverable Format**

Field Number	Field Name	Data Type	Data Length	Description and Comments
1	LabName	text	10	Name of lab performing the work. Used to distinguish among different facilities
2	SDG	text	8	Sample delivery group designation. Always populated for all samples, including QC.
3	FieldID	text	13	Client sample ID as appears on COC with optional lab-assigned suffixes and/or prefixes to make it unique
4	NativeID	text	13	Client sample ID, exactly as on the COC. No prefix or suffix allowed. Used to identify native sample from which other samples are derived (e.g., QAQC Type = "LR", "MS", or "SD").
5	QAQCType	text	2	This is the code for the sample type. Any field sample that is not used as lab QC and is not otherwise marked on the COC should have the designation of "N" (normal field sample). No suffix allowed (i.e., do not add numbers as suffixes to the QAQC Type values as is called for in the IRPIMS guidelines).
6	LRTType	text	3	This is the code for laboratory replicate sample type. Values are: blank (if QAQC Type value is not "LR"), "DL" (dilution), "RE" (re-analysis), "D" (inorganic duplicate), "CF" (confirmation). For multiple dilutions or re-analyses of the same sample, append the replicate number after the LRTType value (i.e., "RE", "RE2", "RE3", etc.).
7	Matrix	text	5	Sample matrix code. Valid values are: "AIR", "WATER", "SOIL", unless otherwise marked on the COC. The use of "liquid", "solid", etc. for lab QC is not allowed.
8	LabsampleID	text	20	Laboratory sample ID. Prefix or suffix is allowed. This is where dilutions or re-extractions are noted. Ex: "D97-11111RE" is acceptable.
9	AnalysisMethod	text	20	Analysis method code. A value in this field Analysis method name. Ex: SW8260A. Cannot have generic names such as "EPA"

Field Number	Field Name	Data Type	Data Length	Description and Comments
10	ExtractionMethod	text	20	Preparation method code. A value in this field is required. If the preparation is described in the method, use "METHOD". If there is no separate preparation required, use "NONE". Note that Total and Dissolved metal analyses are differentiated by the value in this column. Normal, TCLP, and SPLP analytes are also differentiated by the value in this column.
11	SampleDate	Date		Date of sample collection. Value is required for all samples sent to the laboratory and samples derived from those samples. Format: mm/dd/yy
12	ReceiveDate	Date		Date of sample receipt in the lab. Value is required for all samples sent to the laboratory and samples derived from those samples. Format: mm/dd/yy
13	ExtractDate	Date		Date of sample preparation (extraction or digestion). Value is required if the MethodExtraction field value is other than "NONE". Format: mm/dd/yy
14	ExtractTime	Time		Time of sample preparation. Value is required if the MethodExtraction field value is other than "NONE". 24-hour format: hh mm
15	AnalysisDate	Date		Date of sample analysis. Value is required for all records. Format: mm/dd/yy
16	AnalysisTime	Time		Time of sample analysis. Value is required for all records. 24-hour format: hh:mm
17	PercentSolids	number		Percent solids within the sample. Should be zero for water samples.
18	LabLotCtINum	text	10	Control number identifier linking QC samples with normal environmental samples. For example, its value can be a digestion or extraction batch ID.
19	CAS	text	20	CAS number of analyte, if available.
20	ParamID	text	12	Parameter identifier code for the parameter listed in the Analyte field.
21	Analyte	text	40	Name of analyte, chemical name.
22	Result	text	16	Numeric result (in text) of the analysis. Surrogate analytes will be reported in units of percent. All others will be reported in sample concentration units.
23	ExpectedValue	text	16	"100" for surrogates, "0" (zero) for blanks, spike level plus parent result for LCS, and MS/MSD; parent value for lab duplicate; etc
24	Units	text	10	Units of measure used in the analysis. Report "PERCENT" for surrogate analytes and concentration units for all others.
25	Dilution	number		Total dilution reported in the analysis. Default value should be 1 (one). This value should reflect changes to sample preparation amounts as defined by the method (e.g., less sample used for standard VOC analysis).
26	MDL	text	16	Minimum detection limit adjusted for dilution only.
27	RL	text	16	Reporting limit adjusted for dilution only. Equivalent to PQL.
28	LabQualifier	text	10	Lab qualifier for the results, AFCEE QAPP Flags.
29	Surrogate	text	1	Is the chemical a surrogate? Report "Y" for yes or "N" for no.
30	Comments	text	240	Comment field

Field Number	Field Name	Data Type	Data Length	Description and Comments
31	ParValUncert	text	16	Radiological parameter value uncertainty
32	Recovery	number		Percent recovery for MS, SD, LCS, and surrogate compounds.
33	LowerControlLimit	number	10	Lower control limit value for spiked compounds. Reported in percent recovery.
34	UpperControlLimit	number	10	Upper control limit value for spiked compounds. Reported in percent recovery
35	Basis	text	1	Soil on a dry weight basis "D" or water "X"
36	ConcQual	text	1	Concentration qualifiers: "U" non-detect, "J" value between MDL and reporting limit, "E" value exceeds calibration, "=" hit  Qualifier given before consideration is made of the data.
37	MDLAdjusted	text	16	Minimum detection limit adjusted for dilution and percent moisture.
38	RLAdjusted	text	16	Reporting limit adjusted for dilution and percent moisture. Equivalent to PQL.
39	SampleDescription	text	20	Field ID exactly from the COC when the Field ID is greater than the space allotted.
40	LCL	number	10	Lower control limit value for spiked compounds. Reported in the same units of measurement as the Result field value
41	UCL	number	10	Upper control limit value for spiked compounds. Reported in the same units of measurement as the Result field value



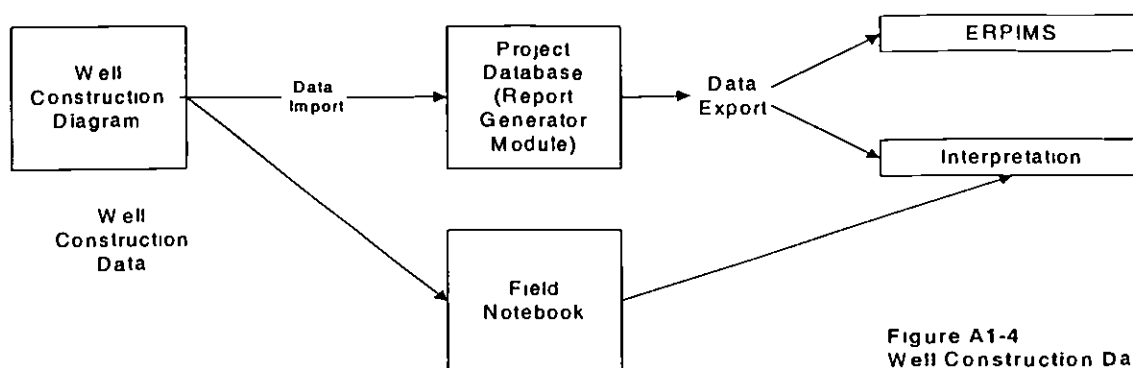


Figure A1-4  
Well Construction Data

### A1.4.5 Well Development Data

The type of information that is collected during development includes the location in the well screen where surging is performed and the duration of surging, flow rate and duration of development pumping stages, static groundwater elevations in the well and water levels during development pumping, observations made during bailing of sediments from the well or during development pumping, and water quality measurements made on the development water throughout the development process. The water quality parameters measured during development include pH, electrical conductivity (EC), turbidity, dissolved oxygen (DO), and temperature. The information collected during development will be recorded in an Excel well development spreadsheet. The electronic files will be imported into the database.

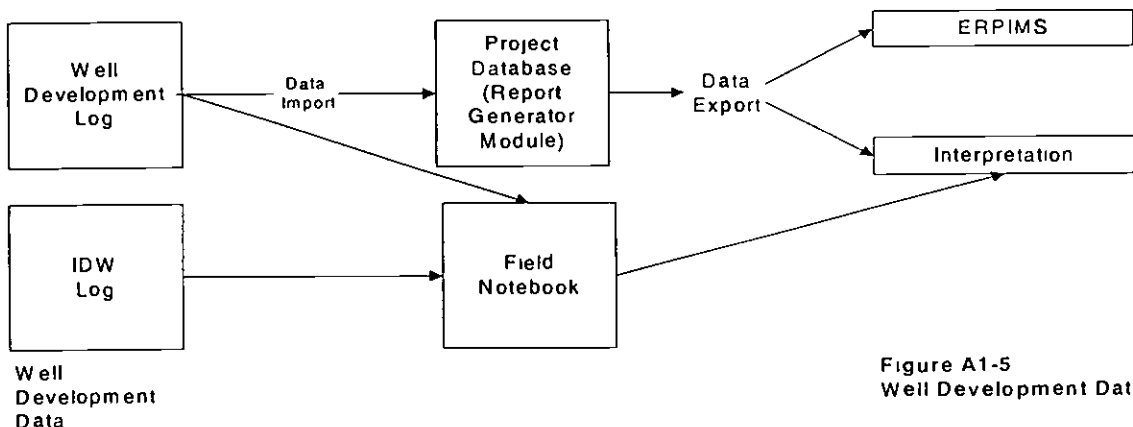


Figure A1-5  
Well Development Data

The well development data process is shown on Figure A1-5

### A1.4.6 Sampling Data

All samples collected in the field and submitted to a laboratory for analysis must be accompanied by a CoC form. The information included on the CoC form will include project name and number, station ID, date and time of sample collection, sample collection method, sample description, number of sample containers, the analyses requested, the date requested for completion of the analysis, the names of personnel collecting the sample, the chain-of-transfers between subsequent personnel handling the sample before it arrived at

the lab, and the date and time of any transfers. Most of this information will be automatically included on the CoC form (using the Field Data module, or equivalent, if one is included in the project database) and the tables therein that are populated with information derived from the approved SAP. The sampling data process is shown on Figure A1-6.

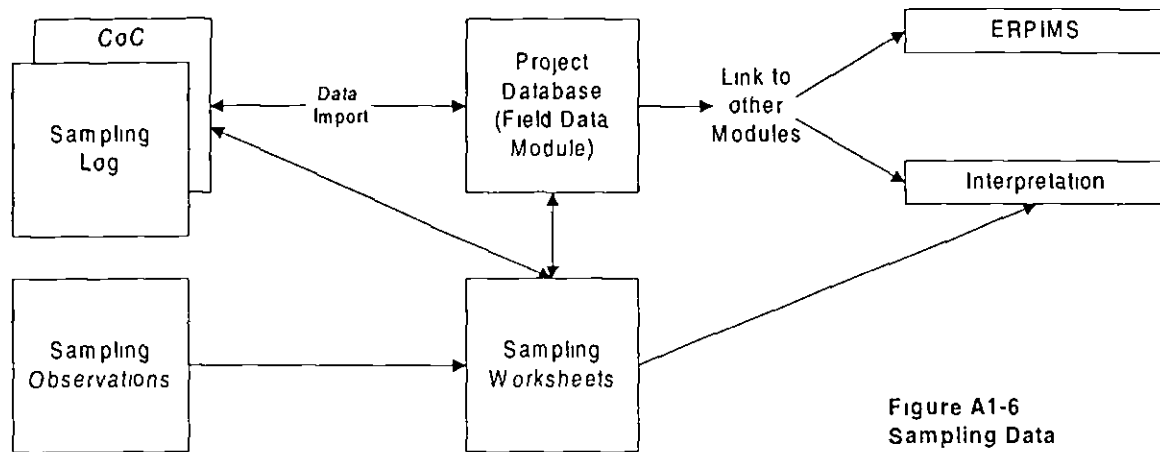


Figure A1-6  
Sampling Data

The information that will be added into the Field Data module database during sampling would include the actual date and time of sample collection, depth of sample collection, sampler initials, and miscellaneous comments

#### A1.4.7 Analytical Data

Most analytical data will be imported electronically (in the Analytical Data module, if one is included in the project database) as described above. The CoC information (from the Field Data module if included) will be downloaded periodically to the project LAN. These data will be used to track project progress, turnaround time compliance, and validation scheduling. The analytical data process is shown on Figure A1-7.

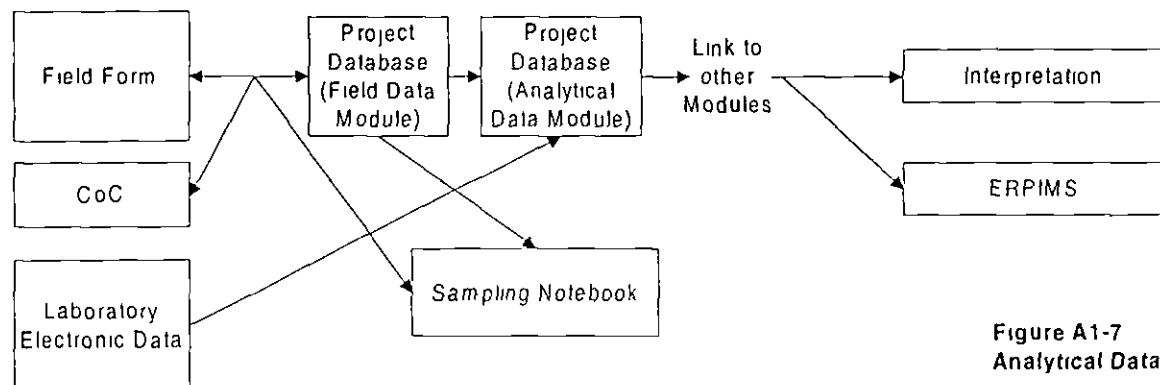


Figure A1-7  
Analytical Data

#### A1.4.8 Analytical Timeliness

The use of the Analytical Data and Data Quality Evaluation modules allows for the loading and validation of data in a real-time mode. As data are received from the laboratories,

loading into an Analytical Data module verifies the completeness of the data vis-a-vis the analyses requested in the Field Data module. In addition, Analytical Data module programming tracks expected delivery dates and notifies the database manager of data that are past their due date. This starts the process of notifying the laboratories and the project team. The project database or its Data Quality Evaluation module can be designed so that the data quality evaluation process occurs as each set of data is received from the laboratories. This allows for rapid dissemination of validated data to the data users for decisionmaking and "course corrections" in the field, when appropriate. In addition, the rapid data quality assessment allows for modifications of laboratory practices or additional audits to correct analytical problems in time to minimize the effect on the remainder of the project. Throughout the project, validated data, validation reports, and data summaries are constantly made available to the project team.

### **A1.4.9 Mobile Lab (when applicable)**

#### **Electronic Data**

Whenever possible, all mobile laboratory data will be generated in an electronic format similar, if not identical, to that for the fixed laboratories. This will allow for the timely and efficient incorporation of data into the project database. When data are unavailable electronically, the use of data entry forms will facilitate the entry and quality control of manually entered data.

#### **Documents**

Documentation of mobile laboratory data will be negotiated with each laboratory. Unlike the fixed laboratories that have the capability to supply data in the format expected by AFCEE, this screening data might be captured in a different hard copy format. The pertinent QC information will be prescribed by the project-specific QAPP and supporting documentation. All mobile laboratory data will be stored and catalogued in the same manner as the fixed laboratory data.

### **A1.4.10 Additional Field Data**

Some field data will be kept in the field project files and not necessarily cataloged or controlled by the data management system

## **A1.5 Data Analysis**

### **A1.5.1 Standardizing the Analytical Results**

Data Standardization involves identifying and standardizing all units associated with each analytical method. Units might be user-specified depending on cleanup criteria comparison or preference. The project database will identify all versions of units within each matrix and analytical method and will convert units to the project-specific units. All reporting and output is generated from the project database or its Report Generator module, if included in the database, in constant units using look-up tables where necessary.

### **A1.5.2 Data Exporting and Report Generation**

When the project database is constructed to include linked modules, the Report Generator module is the module most often used for the following functions:

- Exporting electronic data

- Generating statistical results
- Generating Data Visualization or GIS export files
- Generating data tables for evaluation and presentation
- Generating ERPIMS export files

## **A1.6 Project Closeout**

### **A1.6.1 Final Backup**

Upon completion of the project, the project database modules are backed up onto compact disk and stored both on and offsite.

Laboratory electronic deliverable diskettes or electronic mail files are logged into a project-specific CD and stored with the project database modules.

Original hard copy data reports are logged into the project file and assigned a unique filing ID for easy retrieval. Upon project closeout, the data packages will be archived with the project files.

### **A1.6.2 Data Deliverables**

In addition to the ERPIMS submittals, data will be supplied to the project team to collect, prepare, publish, and distribute data designated on the AFCEE Contract Data Requirements List (CDRL)

Attachment 2  
Quality Control Criteria and Quantitation Limits

## Attachment 2

Table 17

Quality Control Acceptance Criteria for Method SM3500-FE D — Ferrous Iron  
CH2M HILL/REGAFB QAPP

Water (RL) = 0.1 mg/L Accuracy Water (% R) = 75-125 Precision Water (% RPD) = ± 25			
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>
Initial Calibration (4 standards and a blank)	Daily, prior to sample analysis	Correlation coefficient (r) > 0.995  Calibration MUST meet acceptance criteria prior to sample analysis	1) Repeat outlying points 2) Recalculate curve using valid points 3) If still out, correct problem and recalibrate
Initial calibration verification (ICV)	Once per multipoint calibration	Within ± 15% of expected value	1) Repeat ICV or CCV
Continuing calibration verification (CCV)	After every 10 samples	85-115% recovery	2) If still out, identify and correct problem and repeat 3) If still out, repeat initial calibration
Method blank	1 per preparation batch and per analytical batch	< RL	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re-extract/re-analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision
Laboratory control sample (LCS), Matrix spike/matrix spike duplicate (MS/MSD)	1 LCS per preparation and per analytical batch  1 MS/MSD 5% each matrix	75-125 % recovery and RPD < 25%  75-125 % recovery and RPD < 25%	For specific analyte in all samples in the associated analytical batch, if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all non-detects 1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item 1), re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling. If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination <sup>c</sup>
			Apply B to all results for the specific analyte in all samples in the associated analytical batch

Table 17  
Quality Control Acceptance Criteria for Method SM3500-FE D — Ferrous Iron  
CH2M HILL/ARGAFB QAPP

Water (RL) = 0.1 mg/L Accuracy Water (% R) = 75-125 Precision Water (% RPD) = ± 25			
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>
Temperature blank	Every cooler	4°C ± 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary
Field duplicate	Minimum 10% of field samples	RPD < 50%	Project chemist will evaluate results for possible source of variability, notify data users
			Apply B to all results for the specific analyte in all samples in the associated analytical batch
			Apply B to all results for the specific analyte in all samples in the associated analytical batch

- <sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory
- <sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed
- <sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

## Attachment 2

Table 18

Quality Control Acceptance Criteria for Method OA-1/OA 2 (January 1990) Volatile and Extractable Petroleum Hydrocarbons  
CH2M HILL/RGA/B OAPP

RLs - Water, Soil/Sediment TPH - Gasoline = 0.1 mg/L, 1.0 mg/Kg TPH - Diesel = 1.0 mg/L, 10.0 mg/Kg
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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action *	Flagging Criteria *
Five-point initial calibration	Initial Calibration prior to sample analysis	1 RSD $\leq$ 20% 2 Linear - least squares regression $r \geq 0.995$	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification	Daily before sample analysis, and after every 10 samples	Analyzed result within $\pm 15\%$ of the true value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	Gasoline - Water = 67 - 136% Soil = 57 - 146% Diesel - Water = 61 - 143% Soil = 51 - 153%	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method blank	One per analytical batch	No targets detected > RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
LCS	One LCS per analytical batch	Gasoline - Water = 67 - 136% Soil = 57 - 146% Diesel - Water = 61 - 143% Soil = 51 - 153%	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch, if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results if the LCS %R < LCL, apply J to all non-detects
Surrogate Spike	Every sample, spiked sample, standard, and method blank	Gasoline - Water = 74 - 138% Soil = 64 - 148% Diesel - Water = 26 - 152% Soil = 25 - 162%	Correct problem then reprep and analyze sample	For samples, if the %R > UCL, apply J to all positive results. If the %R < LCL, apply J to all positive results, apply R to all non-detects. If %R < 10%, apply R to all results
Gasoline - Chlorobenzene Diesel - Octacosane				For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) MS/MSD RPD > UCL
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	Gasoline - Water = 67 - 136% Soil = 57 - 146% Diesel - Water = 61 - 143% Soil = 51 - 153%	None	Apply R to the result for Gasoline or Diesel in the sample
Retention Time Window	Each Initial Calibration	As specified in SW-846 Method 8000B, Section 7.6	Correct problem then reanalyze all samples analyzed since last retention time check	Apply R to all results for the specific analyte in all samples analyzed
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply F to all results between MDL and RL
Results reported between MDL and RL	None	None	None	RL

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Table 18  
Quality Control Acceptance Criteria for Method OA-1/OA-2 (January 1990) Volatile and Extractable Petroleum Hydrocarbons  
CH2M HILL/ARGAFB OAPP

RLs - Water, Soil/Sediment			
TPH - Gasoline = 0.1 mg/L, 1.0 mg/Kg TPH - Diesel = 1.0 mg/L, 10.0 mg/Kg			
QC Check	Minimum Frequency	Acceptance Criteria	Flagging Criteria <sup>a</sup>
		Corrective Action <sup>a</sup>	

- <sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory
- <sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 1

Quality Control Acceptance Criteria for Radiological Methods  
CH2M HILL/RGAFB QAPP

RL - Water			
E901 1 - Gamma emitting nuclides = 25 pCi/L E900 0 - Gross alpha/beta = 4.0 pCi/L			
RL - Soil/Sediment			
E901 1 - Gamma emitting nuclides 25 pCi/g E900 0 - Gross alpha/beta = 4.0 pCi/g			
QC Check	Minimum Frequency <sup>a</sup>	Acceptance Criteria <sup>c</sup>	Corrective Action <sup>a,c</sup>
E901 1 Gross Gamma			
Geometry specific calibration checks- efficiency calibration checks	Minimum of 10% of field samples	Within 15% +/- counting error of expected value or within historical laboratory derived limits	Recount and recalibrate
Detector calibration checks Energy, efficiency and resolution	Daily	Within +/- 3 sigma of historical mean	1) Replicant recounts 2) Service instrument
Sample Duplicate	Minimum of 10% of samples	Relative error ratio < 1.0	Chemist will evaluate the data for potential cause of variability and notify data users
Detector background	Daily	Within +/- 3 sigma of historical mean	1) Clean detector and shield 2) Recount background
E900 0 Gross Alpha/Beta			
Instrument performance checks	Once daily	Within +/- 3 sigma of historical mean	Recalibrate
ICV and CCV	Once daily	Recovery 85-115% +/- counting error	Evaluate possible source of variability, Repeat measurement
LCS (water samples only), ICV, CCV	One LCS per analytical batch	Recovery 85-115% +/- counting error	Evaluate possible source of variability, Repeat measurement
Method Blank	One per analytical batch	Results- counting error < RL	If sample results are > 10 times the MB then flag the data, if sample results are < 10 times MB results then re-analyze/re-extract
Cross-talk Standard check	Every calibration	Within manufacturers specifications	Adjust HV or discriminator controls, then recalibrate and measure blank
Calibration Verification Standard (Soils only)	Minimum of 10% of samples	Recovery 75-125% +/- counting error	Evaluate possible source of variability, Repeat measurement
Flagging Criteria <sup>b,c</sup>			
Apply R to all results for specific analyte(s) for all samples associated with the calibration			Apply R to all results for specific analyte(s) for all samples associated with the calibration
Apply R to all results for specific analyte(s) for all samples associated with the calibration			Apply R to all results for specific analyte(s) for all samples associated with the calibration
Apply R to all results for all samples analyzed by the analyst			Apply R to all results for all samples analyzed by the analyst

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

<sup>c</sup> These criteria are laboratory-specific and when additional laboratories are identified, these criteria will be updated at the level of effort listed above

## Attachment 2

Table 2

QC Acceptance Criteria for Method SW9030 — Sulfide

CH2M HILL/ARGAFB QAPP

RL - Water = 2.0 mg/L Accuracy Water (% R) = 75-125 Precision Water (RPD) = ±25				RL - Soil = 20 mg/Kg Accuracy Soil (% R) = 75-125 Precision Water (RPD) = ±25			
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>			
Titrant standardization	Daily (prior to sample analysis)	None	None	None			
Initial calibration verification (ICV)	After standardization and before sample analysis	Analyzed result within 90-110% of the true value concentration ±	Correct problem then repeat standardization	Apply R to all results for specific analyte(s) for all samples associated with the standardization			
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst			
Method blank	One per analytical batch	No Sulfide detected > RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch			
LCS for Sulfide	One LCS per analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects			
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > CL			
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte in all samples analyzed			
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL			

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 3  
Quality Control Acceptance Criteria for EPA Draft Method (April 1991) Acid-Volatile Sulfides (AVS)

CH2M HILL/RGA/B QAPP

<p>RLs - Soil/Sediment</p> <p>Acid Volatile Sulfides = 25 mg/Kg</p> <p>Cadmium = 0.5 mg/Kg</p> <p>Copper = 5.0 mg/Kg</p> <p>Mercury = 0.04 mg/Kg</p> <p>Lead = 5.0 mg/Kg</p> <p>Nickel = 4.0 mg/Kg</p> <p>Zinc = 2.0 mg/Kg</p> <p>Accuracy Water (% R) = 75-125</p> <p>Precision Water (RPD) = ±25</p>
--

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action *	Flagging Criteria *
Five-point initial calibration	Daily	Coefficient of correlation Greater than or equal to 0.995	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification	Alter initial calibration and before sample analysis 1 in 10 analytical samples	Analyzed result within 90-110% of the true value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method blank	One per analytical batch	No targets detected > RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
LCS	One LCS per analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > UCL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

\* All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

\* Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

\* Simultaneously extracted metals acceptance criteria is defined for the appropriate analytical method in the AFCEE QAPP version 2.0

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Attachment 2

Table 4  
Quality Control Acceptance Criteria for Method 1664 — Oil and Grease  
CH2M HILL/URGAFB QAPP

RL - Water = 5 mg/L Accuracy Water (% R) = 75-125 Precision Water (RPD) = ±25				
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action *	Flagging Criteria *
Two-point initial calibration of analytical balance	Daily Initial calibration prior to sample measurements	+/- 10% of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification	Before and after sample measurements are taken	+/- 10% of expected value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method blank	One per analytical batch or 10 % frequency whichever is greater	Not measured > RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
LCS	One per analytical batch or 10 % frequency whichever is greater	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
MS/MSD	One MS/MSD per every 10 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MSMSD RPD > CL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

\* All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
 \* Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 5

Quality Control Acceptance Criteria for Method E130.2 — Total Hardness  
CH2M HILL/RGAFB OAPP

RL - Water = 10 mg/L  
Accuracy Water (% R) = 75 - 125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Titrant standardization Initial calibration verification	Daily (prior to sample analysis) After standardization and before sample analysis	None Analyzed result within 90-110% of the true value concentration $\pm$	None Correct problem then repeat standardization	None Apply R to all results for specific analyte(s) for all samples associated with the standardization.
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method Blank	One per preparation and analytical batch	<RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Laboratory Control Sample (LCS)	One per preparation and analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch If the LCS %R > UCL, apply J to all positive results If the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) MS/MSD RPD > CL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte(s) in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 6

Quality Control Acceptance Criteria for Method E350 — Nitrogen, Ammonia

(E350 1, E350 2, E350 3)

CH2M HILLURGAFB QAPP

RL - Water = 0.3 mg/L Accuracy Water (% R) = 75-125 Precision Water (RPD) = ±25		RL - Soil = 15 mg/Kg Accuracy Soil (% R) = 75-125 Precision Soil (RPD) = ±25		
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Initial Calibration (4 standards and a blank)	Daily before analysis	r > 0.995 Calibration MUST meet acceptance criteria prior to sample analysis	Identify and repeat outlying point(s), recalculate curve using repeated point(s)	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Initial calibration verification (ICV) and continuing calibration verification (ccv)	Daily before first batch is analyzed	Response within ±15%	1) Repeat continuing calibration verification (ccv) 2) If still out, identify and correct problem 3) Recalibrate and reanalyze all samples analyzed since last valid CCV	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Method blank	1 per preparation batch and analytical batch	< RL	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re-extractive analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS)	1 per preparation batch and analytical batch	75-125 % recovery	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item 1), re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Matrix spike/matrix spike duplicate (MS/MSD)	5% for each matrix	75-125 % recovery and RPD <25%	If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > UCL
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination <sup>c</sup>	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Temperature blank	Every cooler	4°C ± 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD ~ 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed<sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

## Attachment 2

Table 7

Quality Control Acceptance Criteria for Method E353 — Nitrogen, Nitrate-Nitrite  
CH2M HILL/RGAFB QAPP

Water (RL) = 0.1 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Initial Calibration (4 standards and a blank)	Daily, prior to sample analysis	Correlation coefficient (r) > 0.995  Calibration MUST meet acceptance criteria prior to sample analysis	1) Repeat outlying points 2) Recalculate curve using valid points 3) If still out, correct problem and recalibrate	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Initial calibration verification (ICV) Continuing calibration verification (CCV)	Once per multipoint calibration After every 10 samples	Within $\pm 15\%$ of expected value 85-115% recovery	1) Repeat ICV or CCV 2) If still out, identify and correct problem and repeat 3) If still out, repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Method blank	1 per preparation batch and per analytical batch	< RL	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re extract/re-analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS), Matrix spike/matrix spike duplicate (MS/MSD)	1 LCS per preparation and per analytical batch  1 MS/MSD 5% each matrix	75-125 % recovery and RPD < 25% and <30% for water and soil samples, respectively  75-125 % recovery and RPD < 25% and <30% for water and soil samples, respectively	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item 1), re extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling. If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Reduction check samples (same as LCS)	At start of analytical batch	NO3-N peak response must equal NO2-N peak response within $\pm 15\%$	Adjust hydrate concentration	Apply B to all results for the specific analyte in all samples in the associated analytical batch



**Table 7**  
Quality Control Acceptance Criteria for Method E353 — Nitrogen, Nitrate-Nitrite  
CH2M HILL/RGAFB QAPP

Water (RL) = 0.1 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Temperature blank	Every cooler	4°C $\pm$ 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD < 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

- <sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed  
<sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

## Attachment 2

Table 8

Quality Control Acceptance Criteria for Method E300.0 — Anions  
(Sulfate, Phosphate, Nitrate/Nitrite, and Chloride)  
CH2M HILL/RGAFB QAPP

RLs - Water  
Sulfate = 1.0 mg/L  
Phosphate = 0.5 mg/L  
Nitrate/Nitrite = 0.1 mg/L  
Chloride = 1.0 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Initial calibration (4 standards and a blank)	Prior to sample analysis	Correlation coefficient ( $r$ ) > 0.995 Calibration MUST meet acceptance criteria prior to sample analysis	1) Repeat outlying points 2) Recalculate curve using valid points 3) If still out, correct problem and recalibrate	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Initial calibration verification	After initial calibration and before sample analysis	Result within 90 - 110% of the true value	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification (CCV)	Every 10 samples	$\pm 15\%$ true value	1) Reanalyze CCV 2) If still out, identify and correct problem 3) Recalibrate and reanalyze CCV and all affected samples	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Method blank	1 per analytical batch and per preparation batch	All analytes < RL (Practical Quantitation Limits) <sup>c</sup>	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write OGER 2) If preparative method blank does not meet item 1), re-extract/re-analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS)	1 LCS per preparation batch and per analytical batch	75-125% recovery	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a OGER 2) If the preparative LCS fails the acceptance criteria (other than shown in item 1), re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects

Table 8

Quality Control Acceptance Criteria for Method E300.0 — Anions  
(Sulfate, Phosphate, Nitrate/Nitrite, and Chloride)  
CH2M HILL/IGA/FB QAPP

<b>RLs - Water</b> Sulfate = 1.0 mg/L Phosphate = 0.5 mg/L Nitrate/Nitrite = 0.1 mg/L Chloride = 1.0 mg/L Accuracy Water (% R) = 75-125 Precision Water (RPD) = $\pm 25$
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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Matrix spike/ matrix spike duplicate (MS/MSD)	5 % for each matrix	75-125% recovery and RPD < 25%	If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if: (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) MS/MSD RPD > UCL
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination <sup>c</sup>	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Temperature blank	Every cooler	4°C $\pm$ 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD < 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

<sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

## Attachment 2

Table 9

Quality Control Acceptance Criteria for Method E365 — Phosphorous, All Forms

(E365 1, E365 2, E365 3)

CH2M HILL/ARGAFB QAPP

RL - Water  
Phosphorous, All Forms = 0.10 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action *	Flagging Criteria *
Initial calibration (4 standards and a blank)	Daily (prior to sample analysis)	Correlation coefficient ( $r$ ) > 0.995 Calibration MUST meet acceptance criteria prior to sample analysis + 15% true value	Identify and repeat outlying point(s), recalculate curve using repeated point(s) 1) Repeat ICV 2) If not compliant, evaluate system and correct problem 3) Repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
ICV	Daily following initial calibration			Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification (CCV)	Daily, before sample analysis, after every 10 samples, and at the end of each batch	$\pm 15\%$ true value	1) Reanalyze CCV 2) If still out, identify and correct problem 3) Recalibrate and reanalyze all samples since last valid CCV	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Method blank	1 per analytical batch and per preparation batch	< RL	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re-extract/re-analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS)	1 per preparation batch and analytical batch	75-125% recovery	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item 1), re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Matrix spike/matrix spike duplicate (MS/MSD)	5% for each matrix	75-125% recovery and RPD < 25%	If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) MS/MSD RPD > UCL

**Table 9**  
Quality Control Acceptance Criteria for Method E365 — Phosphorous, All Forms  
(E365 1, E365 2, E365 3)  
CH2M HILL/RGAFB QAPP

RL- Water  
Phosphorous, All Forms = 0.10 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) = ±25

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>a</sup>
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample contamination <sup>c</sup>	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Temperature blank	Every cooler	4°C ± 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD < 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

- <sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory
- <sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed
- <sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

## Attachment 2

Table 10

Quality Control Acceptance Criteria for Method E375 — Sulfate

(E375 1, E375 2, E375 3, E375 4)

CH2M HILL/RGAFB QAPP

RL - Water = 1.0 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action *	Flagging Criteria *
Initial calibration (4 standards and a blank)	Daily (prior to sample analysis)	Correlation coefficient ( $r$ ) > 0.995 Calibration MUST meet acceptance criteria prior to sample analysis	Identify and repeat outlying point(s), recalculate curve using repeated point(s)	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Initial calibration verification	After initial calibration and before sample analysis	Result within 90 - 110% of the true value	Correct problem then repeat initial calibration	Apply R to all results for all samples associated with the calibration
Continuing calibration verification (CCV)	Every 10 samples	$\pm 20\%$ true value	1) Reanalyze CCV 2) If still out, identify problem	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Method blank	1 per preparation batch and per analytical batch	< RL (Practical Quantitation Limits)	3) Recalibrate and reanalyze all samples since last valid CCV 1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re-extract/analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS)	1 per preparation batch and per analytical batch	75-125% recovery	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Matrix spike/matrix spike duplicate (MS/MSD)	5% for each matrix	75-125% recovery and RPD < 25%	If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) MS/MSD RPD > UCL

Table 10  
Quality Control Acceptance Criteria for Method E375 — Sulfate  
(E375 1, E375 2, E375 3, E375 4)  
CH2M HILL/RGAFB QAPP

RL - Water = 1.0 mg/L  
Accuracy Water (% R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination <sup>c</sup>	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Temperature blank	Every cooler	4°C $\pm$ 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD ~ 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

- <sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory
- <sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed
- <sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

Attachment 2

Table 11

Quality Control Acceptance Criteria for Method E325 — Chloride

(E325 1, E325 2, E325 3)

CH2M HILL/URGAFB OAPP

RL- Water =10 mg/L  
Accuracy (%R) = 75-125  
Precision Water (RPD) = ±25

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action *	Flagging Criteria *
Titrant standardization	Daily (prior to sample analysis)	None	None	None
Initial calibration verification (ICV)	After standardization and before sample analysis	Analyzed result within 90-110% of the true value concentration ±	Correct problem then repeat standardization	Apply R to all results for specific analyte(s) for all samples associated with the standardization
Method blank	1 per preparation batch and per analytical batch	< RL	1) If sample analyte concentration is < RL or if the sample analyte concentration is > 10 times the concentration in the method blank, then report results and write QCER 2) If preparative method blank does not meet item 1), re-extract/re-analyze if still within HT and enough sample volume, if not within HT or enough sample, contact project QA officer for decision	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Laboratory control sample (LCS)	1 per preparation batch and per analytical batch	75-125% recovery	1) If the preparative LCS recovers high outside the acceptance criteria and the analyte is ND, flag the LCS results and write a QCER 2) If the preparative LCS fails the acceptance criteria (other than shown in item re-extraction and reanalysis will be necessary if samples are still within holding time and enough sample volume, if not, contact the project QA officer for a decision for possible resampling	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Matrix spike/matrix spike duplicate (MS/MSD)	5% for each matrix	75-125% recovery and RPD < 25%	If the MS and/or MSD is outside of either accuracy or precision tolerances and LCS results are acceptable, flag MS/MSD results and write QCER	For the specific analyte in all samples collected from the same site matrix as the parent, apply M if (1)%R for MS or MSD > UCL or (2)%R for MS or MSD < LCL or (3)MS/MSD RPD > UCL
Equipment blank	10% per site per matrix	< RL	Immediately notify project QA officer or field chemist so they can correct sampling or sample transfer procedures to eliminate contamination *	Apply B to all results for the specific analyte in all samples in the associated analytical batch



**Table 11**  
Quality Control Acceptance Criteria for Method E325 — Chloride  
(E325 1, E325 2, E325 3)  
CH2M HILL/RGA/FB QAPP

RL- Water = 10 mg/L  
Accuracy (%R) = 75-125  
Precision Water (RPD) =  $\pm 25$

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Temperature blank	Every cooler	4°C $\pm$ 2°C	Immediately notify project QA officer or field chemist so they can modify sample packing and/or preservation procedures, recollect samples if necessary	Apply B to all results for the specific analyte in all samples in the associated analytical batch
Field duplicate	Minimum 10% of field samples	RPD - 50%	Project chemist will evaluate results for possible source of variability, notify data users	Apply B to all results for the specific analyte in all samples in the associated analytical batch

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

<sup>c</sup> If equipment blank is submitted to the laboratory blind, the corrective action is not applicable

## Attachment 2

Table 12

QC Acceptance Criteria for Method RSK-114/175 — Methane/Ethane/Ethene  
CH2M HILL/ARGAFB QAPP

RL - Methane = 0.5 ug/L
RL - Ethane = 0.7 ug/L
RL - Ethene = 0.7 ug/L
Accuracy Water (% R) = 80 - 120
Precision Water (RPD) = ±20

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action *	Flagging Criteria *
Seven-point initial calibration for RSK-114/175	Initial calibration prior to sample analysis	Coefficient of correlation Greater than or equal to 0.995	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing calibration verification	After initial calibration and before sample analysis	All analytes recovered within ± 20% of expected concentration	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method (purge) blank	One per analytical batch	No MEE detected > RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte in all samples in the associated analytical batch
LCS for MEE	One LCS per analytical batch	QC acceptance criteria 80-120% recovery	Correct problem then reprep and analyze the LCS and all samples in the affected analytical batch	For specific analyte in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to non-detects
Duplicate	One duplicate per analytical batch	QC acceptance criteria, Table	None	None
MDL study	Once per year	Detection limits established shall be < the RLs	None	None
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

\* All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

• Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

RL footnote—RL depends on the volume of headspace generated RLs are typical estimates

Attachment 2

Table 13

Quality Control Acceptance Criteria for Method E160.1 — Total Dissolved Solids  
CH2M HILL/RGA/FB QAPP

RL - Water = 20 mg/L  
Accuracy Water (% R) = 70 - 130  
Precision Water (RPD) = ±30

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action *	Flagging Criteria *
Method Blank	One per preparation and analytical batch	<RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Laboratory Control Sample (LCS)	One per preparation and analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-defects
Duplicate	One per preparation and analytical batch	RPD < 30%	None	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) MS/MSD RPD > CL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte(s) in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

\* All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

† Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 14

Quality Control Acceptance Criteria for Method E160.2 — Total Suspended Solids  
CH2M HILL/RGAFB QAPP

RL - Water = 10 mg/L Accuracy Water (% R) = 70 - 130 Precision Water (RPD) = ±30				
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Method Blank	One per preparation and analytical batch	<RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Laboratory Control Sample (LCS)	One per preparation and analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detects
Duplicate	One per preparation and analytical batch	RPD < 30%	None	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) MS/MSD RPD > CL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte(s) in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

Attachment 2

Table 15

Quality Control Acceptance Criteria for Method E310.1 — Total Alkalinity

CH2M HILL/USAFB OAPP

<p>RL - Water = 10 mg/L Accuracy Water (% R) = 75 - 125 Precision Water (RPD) = <math>\pm 25</math></p>
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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>a</sup>
Titrant standardization	Daily (prior to sample analysis)	None	None	None
Initial calibration verification (ICV)	After standardization and before sample analysis	Analyzed result within 90-110% of the true value concentration $\pm$	Correct problem then repeat standardization	Apply R to all results for specific analyte(s) for all samples associated with the standardization
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Method Blank	One per preparation and analytical batch	<RL	Correct problem then reprep and analyze method blank and all samples processed with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Laboratory Control Sample (LCS)	One per preparation and analytical batch	QC acceptance criteria, Table	Correct problem then reprep and analyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results apply R to all non-defects
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) MS/MSD RPD > CL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte(s) in all samples analyzed
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory

<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

## Attachment 2

Table 16

Quality Control Acceptance Criteria for Method SW9060 (Modified)—Total Organic Carbon  
CH2M HILL/RGAFB QAPP

RL - Water = 1.0 mg/L Accuracy Water (% R) = 80 - 120 Precision Water (RPD) = $\pm 20$	RL - Soil = 5.0 mg/kg Accuracy Soil (% R) = 80 - 120 Precision Soil (RPD) = $\pm 20$
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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action <sup>a</sup>	Flagging Criteria <sup>b</sup>
Initial Calibration - single or multi-point calibration depending on manufacturer's recommendation for instrumentation	Daily before analysis	For multi-point calibration curve, regression criteria of $r^2 > 0.995$ MUST be met prior to sample analysis	For single point - repeat initial point calibration, identify and repeat outlying point(s), recalculate curve using repeated point(s)	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Second source calibration verification (ICV)	Once per calibration After initial calibration and before sample analysis	Analyzed result within $\pm 10\%$ of the true value concentration For single point calibrations, ICV standard shall be at half the concentration of the initial calibration standard	Correct problem then repeat initial calibration	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Initial Calibration Blank (ICB)	One per initial calibration	<RL	Correct problem then reanalyze ICV and ICB in sequence	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Continuing calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	Response within $\pm 10\%$	1) Repeat continuing calibration verification (CCV) 2) If still out, identify and correct problem 3) Recalibrate and reanalyze all samples	Apply R to all results for specific analyte(s) for all samples associated with the calibration
Continuing Calibration Blank	One per preparation and analytical batch	<RL	Correct problem then reanalyze CCV and CCB and all samples associated with the contaminated blank	Apply B to all results for the specific analyte(s) in all samples in the associated analytical batch
Laboratory Control Sample (LCS)	One per every 20 samples or analysis batch whichever is the more frequent	QC acceptance criteria, Table	Correct problem and reanalyze the LCS and all samples in the affected AFCEE analytical batch	For specific analyte(s) in all samples in the associated analytical batch if the LCS %R > UCL, apply J to all positive results if the LCS %R < LCL, apply J to all positive results, apply R to all non-detected
MS/MSD	One MS/MSD per every 20 Air Force project samples per matrix	QC acceptance criteria, Table	None	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply M if (1) %R for MS or MSD > UCL or (2) %R for MS or MSD < LCL or (3) MS/MSD RPD > CL
MDL study	Once per year	Detection limits established shall be < the RLs in Table	None	Apply R to all results for the specific analyte(s) in all samples analyzed
Demonstrate ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample	Once per analyst	QC acceptance criteria, Table	Recalculate results, locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria	Apply R to all results for all samples analyzed by the analyst
Results reported between MDL and RL	None	None	None	Apply F to all results between MDL and RL

Table 16  
Quality Control Acceptance Criteria for Method SW9060 (Modified)— Total Organic Carbon  
CH2MHILL/SGAFB OAPP

QC Check	Minimum Frequency	RL - Water = 1.0 mg/L Accuracy Water (% R) = 80 - 120 Precision Water (RPD) = ±20	RL - Soil = 5.0 mg/kg Accuracy Soil (% R) = 80 - 120 Precision Soil (RPD) = ±20	Flagging Criteria <sup>b</sup>
		Acceptance Criteria	Corrective Action <sup>a</sup>	

<sup>a</sup> All corrective actions associated with AFCEE project work shall be documented, and all records shall be maintained by the laboratory  
<sup>b</sup> Flagging criteria are applied when acceptance criteria were not met and corrective action was not successful or corrective action was not performed

**Attachment 3**  
**Laboratory EDD Format**

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ATTACHMENT 3  
Laboratory EDD Format  
CH2M HILL/RGA/FB QAPP

Electronic Data Deliverable Format

Field Number	Field Name	Data Type	Data Length	Description and Comments
1	LabName	text	10	Name of lab performing the work. Used to distinguish among different facilities.
2	SDG	text	8	Sample delivery group designation. Always populated for all samples, including QC.
3	FieldID	text	13	Client sample ID as appears on COC with optional lab-assigned suffixes and/or prefixes to make it unique.
4	NativeID	text	13	Client sample ID, exactly as on the COC. No prefix or suffix allowed. Used to identify native sample from which other samples are derived (e.g., QAQC Type = "LR", "MS", or "SD").
5	QAQCType	text	2	This is the code for the sample type. Any field sample that is not used as lab QC and is not otherwise marked on the COC should have the designation of "N" (normal field sample). No suffix allowed (i.e., do not add numbers as suffixes to the QAQC Type values as is called for in the IRPIMS guidelines).
6	LRTYPE	text	3	This is the code for laboratory replicate sample type. Values are: blank (if QAQC Type value is not "LR"), "DL" (dilution), "RE" (re-analysis), "D" (inorganic duplicate), "CF" (confirmation).  For multiple dilutions or re-analyses of the same sample, append the replicate number after the LRTYPE value (i.e., "RE", "RE2", "RE3", etc.).
7	Matrx	text	5	Sample matrix code. Valid values are: "AIR", "WATER", "SOIL", unless otherwise marked on the COC. The use of "liquid", "solid", etc. for lab QC is not allowed.
8	LabsampleID	text	20	Laboratory sample ID. Prefix or suffix is allowed. This is where dilutions or re-extractions are noted. Ex: "D97-11111RE" is acceptable.
9	AnalysisMethod	text	20	Analysis method code. A value in this field Analysis method name. Ex. SW8260A. Cannot have generic names such as "EPA".

Field Number	Field Name	Data Type	Data Length	Description and Comments
10	ExtractionMethod	text	20	Preparation method code. A value in this field is required. If the preparation is described in the method, use "METHOD". If there is no separate preparation required, use "NONE". Note that Total and Dissolved metal analyses are differentiated by the value in this column. Normal, TCLP, and SPLP analytes are also differentiated by the value in this column.
11	SampleDate	Date		Date of sample collection. Value is required for all samples sent to the laboratory and samples derived from those samples. Format: mm/dd/yy
12	ReceiveDate	Date		Date of sample receipt in the lab. Value is required for all samples sent to the laboratory and samples derived from those samples. Format: mm/dd/yy
13	ExtractDate	Date		Date of sample preparation (extraction or digestion). Value is required if the MethodExtraction field value is other than "NONE". Format: mm/dd/yy
14	ExtractTime	Time		Time of sample preparation. Value is required if the MethodExtraction field value is other than "NONE". 24-hour format: hh:mm
15	AnalysisDate	Date		Date of sample analysis. Value is required for all records. Format: mm/dd/yy
16	AnalysisTime	Time		Time of sample analysis. Value is required for all records. 24-hour format: hh:mm
17	PercentSolids	number		Percent solids within the sample. Should be zero for water samples.
18	LabLotCtlNum	text	10	Control number identifier linking QC samples with normal environmental samples. For example, its value can be a digestion or extraction batch ID.
19	CAS	text	20	CAS number of analyte, if available.
20	ParamID	text	12	Parameter identifier code for the parameter listed in the Analyte field.
21	Analyte	text	40	Name of analyte, chemical name.
22	Result	text	16	Numeric result (in text) of the analysis. Surrogate analytes will be reported in units of percent. All others will be reported in sample concentration units.
23	ExpectedValue	text	16	"100" for surrogates; "0" (zero) for blanks; spike level plus parent result for LCS, and MS/MSD; parent value for lab duplicate; etc.
24	Units	text	10	Units of measure used in the analysis. Report "PERCENT" for surrogate analytes and concentration units for all others.
25	Dilution	number		Total dilution reported in the analysis. Default value should be 1 (one). This value should reflect changes to sample preparation amounts as defined by the method (e.g., less sample used for standard VOC analysis).
26	MDL	text	16	Minimum detection limit adjusted for dilution only.
27	RL	text	16	Reporting limit adjusted for dilution only. Equivalent to PQL.
28	LabQualifier	text	10	Lab qualifier for the results, AFCEE QAPP Flags.
29	Surrogate	text	1	Is the chemical a surrogate? Report "Y" for yes or "N" for no.
30	Comments	text	240	Comment field

Field Number	Field Name	Data Type	Data Length	Description and Comments
31	ParVailUncert	text	16	Radiological parameter value uncertainty.
32	Recovery	number		Percent recovery for MS, SD, LCS, and surrogate compounds.
33	LowerControlLimit	number	10	Lower control limit value for spiked compounds. Reported in percent recovery.
34	UpperControlLimit	number	10	Upper control limit value for spiked compounds. Reported in percent recovery.
35	Basis	text	1	Soil on a dry weight basis "D" or water "X"
36	ConcQual	text	1	Concentration qualifiers. "U" non-detect, "J" value between MDL and reporting limit, "E" value exceeds calibration, "=" hit
				Qualifier given before consideration is made of the data.
37	MDLAdjusted	text	16	Minimum detection limit adjusted for dilution and percent moisture.
38	RLAdjusted	text	16	Reporting limit adjusted for dilution and percent moisture. Equivalent to PQL.
39	SampleDescription	text	20	Field ID exactly from the COC when the Field ID is greater than the space allotted.
40	LCL	number	10	Lower control limit value for spiked compounds. Reported in the same units of measurement as the Result field value.
41	UCL	number	10	Upper control limit value for spiked compounds. Reported in the same units of measurement as the Result field value.

# TAB

*HSP*

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**Installation Restoration Program  
Basewide Remedial Investigation / Feasibility Study Work Plan  
for  
Richards-Gebaur Air Force Base**

**HEALTH AND SAFETY PLAN**

October 1999

Prepared for

**Air Force Center for Environmental Excellence (AFCEE)**  
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Prepared by

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USAF Contract No. F41624-97-D-8019  
Delivery Order 0090

## Notice

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This report was prepared for the U.S. Air Force (USAF) by CH2M HILL for the purpose of aiding in the implementation of Basewide Remedial Investigation / Feasibility Study (RI/FS) activities at Richards-Gebaur Air Force Base (AFB), Missouri under the Installation Restoration Program (IRP). The limited objective of this report and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this report premature or inaccurate. Acceptance of this report in performance of the contract under which it is prepared does not mean that the USAF adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the USAF.

# Preface

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This Health and Safety Plan (HSP) prepared by CH2M HILL describes field safety procedures for conducting field work for Basewide RI/FS activities at Richards-Gebaur AFB, Missouri. CH2M HILL is conducting the work under contract with the Air Force Center for Environmental Excellence (AFCEE), Brooks AFB, Texas. Ms. Kay Grosinske is the AFCEE Team Chief. CH2M HILL's Project Manager is Mr. Peter Barrett. Mr. Mike Nicklow is the Air Force Base Conversion Agency (AFBCA) representative.

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# Acronyms

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AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AOC	area of concern
APR	air purifying respirators
AST	aboveground storage tank
BTC	Belton Training Complex
BTEX	benzene, toluene, ethylbenzene, and xylenes
COC	contaminants of concern
COR	Contracting Officer's Representative
CS	compliance site
dB	decibel
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
F.A.C	Florida Administrative Code
FA-CPR	First Aid Cardiopulmonary Resuscitation
FID	flame ionization detector
FDEP	Florida Department of Environmental Protection
HSP	Health and Safety Plan
IDLH	immediately dangerous to life and health
IDW	investigation-derived waste
IRP	Installation Restoration Program
kV	kilovolt
LEL	lower explosive limit
mg/m <sup>3</sup>	milligrams per cubic meter
MSDS	Material Safety Data Sheet
MSL	mean sea level
NA	not applicable
NSC	National Safety Council
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
OVA	organic vapor analyzer
OVS	oil/water separator
PAH	polyaromatic hydrocarbons
PEL	permissible exposure limit
PID	photoionization detector
PFD	personal flotation devices
PIP	photoionization potential
POL	petroleum, oils, and lubricants
PPE	personal protective equipment
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
REL	recommended exposure limit
RFI	RCRA Facility Investigation

## Acronyms (Continued)

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RI/FS	Remedial Investigation/Feasibility Study
RMSF	Rocky Mountain Spotted Fever
SCBA	self contained breathing apparatuses
SOP	standard of practice
SSC	Site Safety Coordinator
SVOCs	semivolatile organic compounds
TLV	threshold limit value
TPH	total petroleum hydrocarbons
TVH	total volatile hydrocarbons
USAF	U.S. Air Force
UST	underground storage tank
VOCs	volatile organic compounds
µg/L	micrograms per liter

# 1.0 Introduction

---

The CH2M HILL HSP will be kept onsite during field activities and will be reviewed and updated as necessary. This plan adopts, by reference, the standard operating procedures (SOPs) contained in the CH2M HILL *Corporate Health and Safety Program–Program and Training Manual*, and other applicable CH2M HILL SOPs as appropriate. The Site Safety Coordinator (SSC) is to be familiar with these SOPs. In addition, this plan adopts procedures contained in the work plan for the project.

Project Number: ..... 153673  
 Project Manager: ..... Peter Barrett  
 Office: ..... St. Louis, MO  
 Site Name: ..... Richards-Gebaur Air Force Base (AFB)  
 Date Health and Safety Plan Prepared: ..... July 1999  
 Date Health and Safety Plan Revised: ..... N/A  
 Date(s) of Initial Visit: ..... August 1998  
 Date(s) of Site Work: ..... October 1999 – December 1999

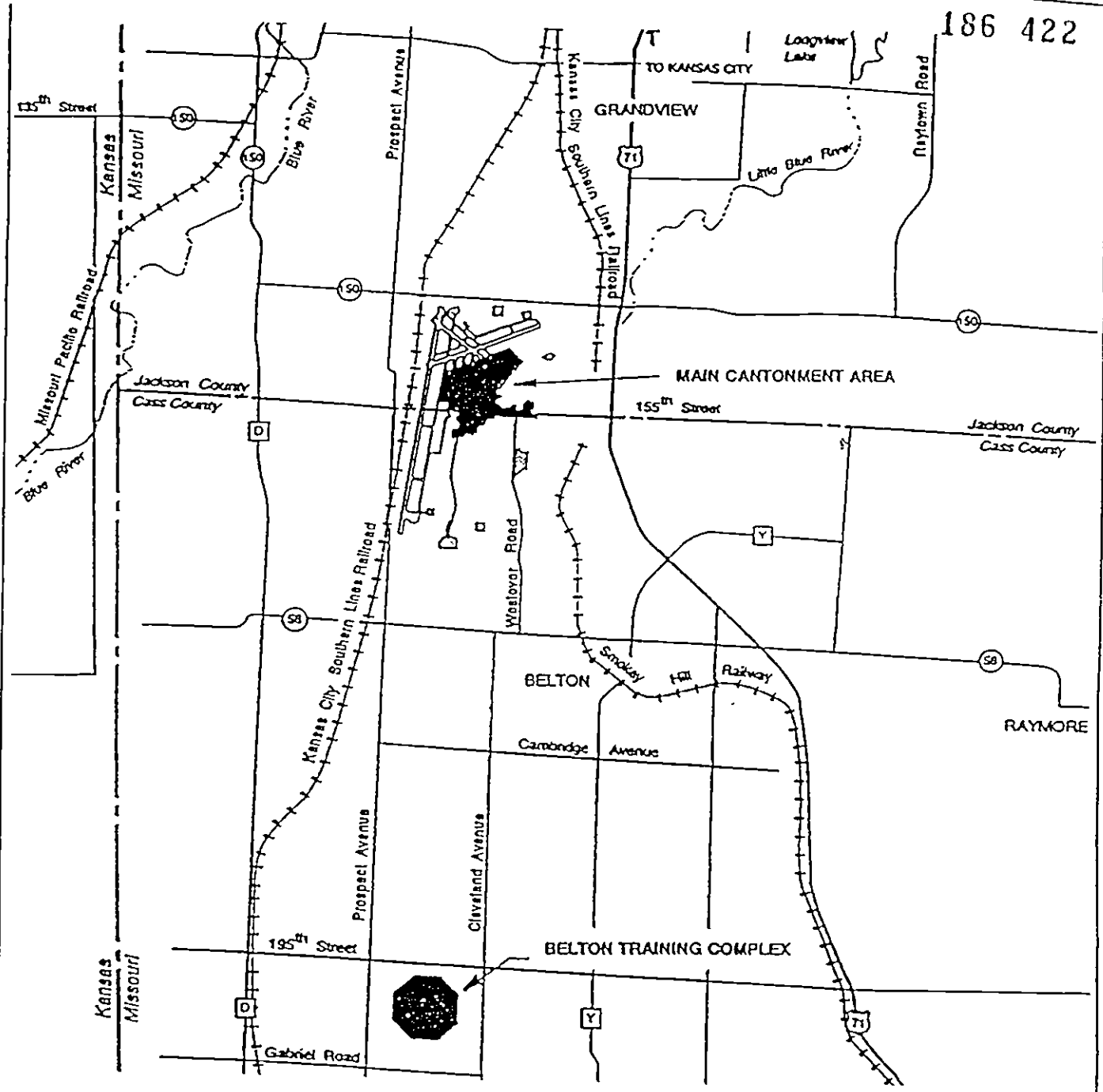
## 1.1 Access

As shown in **Exhibit 1-1**, Richards-Gebaur AFB is located in west-central Missouri, approximately 18 miles south of downtown Kansas City, and 3 miles east of the Kansas-Missouri State line. The northern portion of the Base is located in Jackson County, and the southern portion lies in Cass County. The Base is surrounded by the City of Belton on the east and south, and is bounded by Kansas City to north and west.

Richards-Gebaur AFB presently comprises 426 acres of land distributed in 11 parcels. The largest parcel is the Cantonment Area, the operational center of the Base, which is 208 acres in size. The Belton Training Complex, located approximately four miles south of the Cantonment Area, consists of 184 acres of largely undeveloped land.

The remaining acreage is subdivided into nine parcels ranging between 1 acre and 13 acres in size. Three safety easements are also held by the Air Force: a 20-acre easement adjacent to the Small Arms Range; a 106-acre easement surrounding the Weapons Bunker; and a 287-acre easement around the Belton Training Complex.

**Exhibit 1-2** presents the layout of the base and the locations of the sites to be investigated under this HSP.



EXPLANATION





-  Base Property
-  U. S. Highway
-  State Highway
-  County Road



Exhibit 1-1

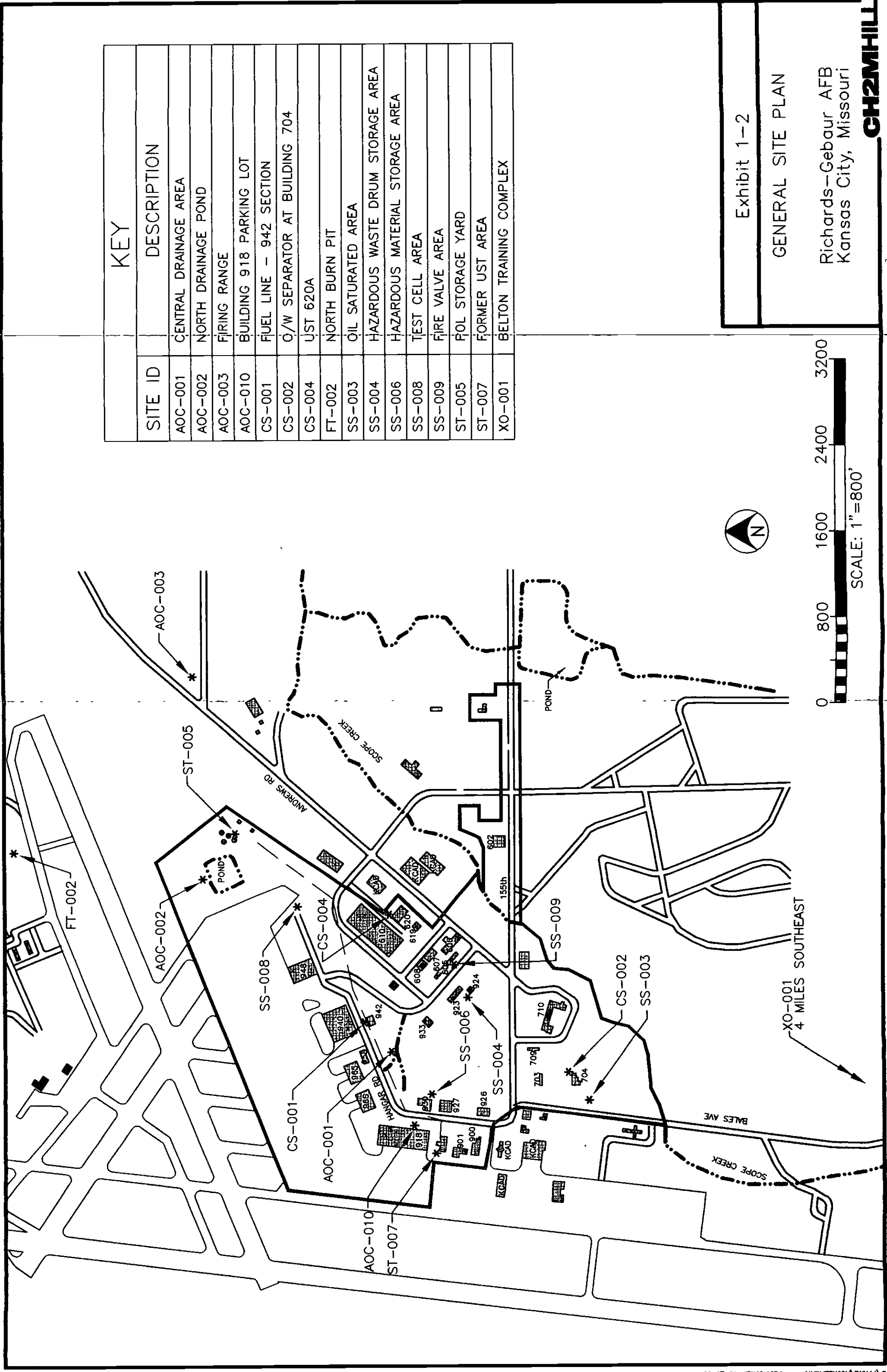
LOCATION MAP OF  
RICHARDS-GEBAUR AFB

Richards-Gebaur AFB  
Kansas City, Missouri

**CH2MHILL**

F:\144012\FIGURE2.DWG PLOT DATE: 10-26-98

AFTER DAMES & MOORE, 1995





## 1.2 Base Setting

Richards-Gebaur AFB is characterized by low relief, wide, maturely dissected uplands, and relatively steep valley slopes carved on sedimentary rocks of Pennsylvanian age. The topography of the Base is gently rolling, with ground surface elevations ranging from 960 feet above mean sea level (MSL) on the northeast side of the Base to over 1,125 feet MSL on the south property margin. The Base is situated on a broad plateau called the Blue Ridge, with the Blue River bordering to the west and the Little Blue River to the east. Both rivers are confluent to the Missouri River about 20 miles north of the Base.

Richards-Gebaur AFB and its surrounding area are characterized by a modified continental climate that is influenced by disparate air masses from the Gulf of Mexico and Canada. This weather system creates rapid changes in the local climate. Severe thunderstorms, including tornadoes, are common in spring and summer. The prevailing wind direction at the Base is from the south, with an average annual wind speed of 9 knots.

The mean monthly temperature at the Base is 54.9 ° F, ranging from 28 ° F in January to 79 ° F in July. The average annual precipitation is 37.9 inches, with the majority rainfall typically occurring in the late spring, early summer and early fall, when warm, wet air currents from the Gulf of Mexico collide with cold, dry continental air from Canada. The average seasonal snowfall is 21.6 inches, but historically has varied from less than a foot to over 60 inches in depth.

## 2.0 Background

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### 2.1 Site Descriptions and Histories

CH2M HILL will conduct a Basewide RI/FS at Richards-Gebaur AFB. Field operations conducted during the RI will consist of site characterization activities at the 16 sites:

- AOC 001: Central Drainage Area
- AOC 002: North Drainage Area
- AOC 003: Firing Range
- AOC 010: Building 918 Parking Lot
- CS 001: Fuel Line – 942 Section
- CS 002: Oil / Water Separator at Building 704
- CS 004: UST 620A
- FT 002: North Burn Pit (FTA)
- SS 003: Oil Saturated Area
- SS 004: Hazardous Waste Drum Storage Area
- SS 006: Hazardous Material Storage Area
- SS 008: Test Cell Area
- SS 009: Fire Valve Area
- ST 005: Petroleum, Oil, and Lubricants (POL) Storage Yard
- ST 007: Former UST Area
- XO 001: Belton Training Complex (BTC)

Descriptions of each site are provided below

#### 2.1.1 AOC 001: Central Drainage Area

AOC 001, the Central Drainage Area, is located in the northwestern portion of Richards-Gebaur AFB, south of the flightline and Hangar Road and northeast of Building 930. The Central Drainage Area collects and channels surface water runoff from the runways and flightline through the central area of the Base.

The site was initially investigated in 1993. The results of the investigation indicated the presence of metals and trace amounts of organic solvent in the sediments.

#### 2.1.2 AOC 002: North Drainage Pond

AOC 002, the North Drainage Pond, is located in the northeast portion of Richards-Gebaur AFB. The site was constructed in 1975 to collect surface runoff from the flightline and runways located topographically upgradient to the north and west. The retention pond covers an area of about 36,000 square feet. The impoundment conveys the collected runoff to the Little Blue River Sewage Treatment Plant via sanitary sewers.

An environmental assessment at the North Drainage Pond site, performed by Tetra Tech in 1993, found several potential chemicals of concern (COC) in the pond sediments, including polyaromatic hydrocarbons (PAH) and diesel range hydrocarbons.

### **2.1.3 AOC 003: Firing Range**

AOC 003 is a former small arms firing range. It is located approximately 1,000 feet east of Andrews Road in the northeast portion of Richards-Gebaur AFB. The site was constructed in 1956 and occupies approximately 2,300 square feet of ground area.

The Firing Range was initially assessed in 1988 as part of a base-wide environmental study. In 1993, a follow-up investigation was conducted. The results indicated trace concentrations of heavy metals, particularly lead, in surface soils.

### **2.1.4 AOC 010: Building 918 Parking Lot**

AOC 010 is located in the parking lot east of Building 918 along Hangar Road. The site corresponds to an area of undetermined size above the subsurface fuel hydrant line that passes beneath the paved parking lot in this part of the Base.

The site was identified during a 1992 soil gas survey when elevated soil gas readings for total volatile hydrocarbons (TVH) were recorded in the area.

### **2.1.5 CS 001: Fuel Line – 942 Section**

CS 001 is located south of Hangar Road, approximately 50 feet north of Building 942 at the bottom of a steep, grass embankment. The site covers approximately 14,000 square feet of ground surface. It was contaminated by a leak from the former fuel hydrant line that transferred jet fuel from the POL Yard west to the flightline USTs.

The fuel leak behind Building 942 was identified during a Hydrant Piping Study conducted in 1993. As a result, approximately 930 cubic yards of soil were removed from the site in 1995.

### **2.1.6 CS 002: Oil / Water Separator at Building 704**

CS 002 is located south of 155th Street and east of Bales Avenue, at the northeast corner of Building 704. The site occupies approximately 1,200 square feet. From 1956 through 1993, a 250-gallon capacity water holding tank and a 500-gallon capacity oil/water separator (OWS) were used to store vehicle wash-water and receive residual wash-water following vehicle cleaning.

In 1993, the two tanks were removed as part of an Air Force project to upgrade USTs at the Base. Evidence of petroleum hydrocarbon contamination was observed during the tank removal.

### **2.1.7 CS 004: UST 620A**

CS 004 is an UST site located at the northwest corner of Building 620. The site occupies about 400 square feet of ground surface. The former UST, now removed, was used between 1966 and 1988 to receive waste liquids from the adjacent Air Force fuel testing laboratories. The waste stream stored in this tank was estimated by Air Force personnel to be composed of approximately 70% fuel, 28% water, and 2% acid.

As part of a 1988 Air Force project, the UST was removed. Soil sample analytical results indicated the presence of total petroleum hydrocarbons (TPH) constituents in the soil that surrounded the UST.

### **2.1.8 FT 002: North Burn Pit (FTA)**

FT 002 is located north of the airfield, several hundred feet inside the north boundary of the Base. The site is approximately 250,000 square feet in size. It was used for fire department training from 1965 to 1988. Waste oils, solvents, and fuels were stored in drums and burned at the facility until 1969; only JP-4 fuel was ignited after this date. Reportedly, small quantities of fuel have been spilled at the site during the fire training exercises. One such release reportedly resulted in a fish kill in the Little Blue River. In addition, one incident of failure of one OWS onsite was reported.

### **2.1.9 SS 003: Oil Saturated Area**

SS 003 is located south of 155th Street, southwest of Building 704. The site is adjacent to the waste oil storage area and covers approximately 1,600 square feet. SS 003 was used as a waste oil storage area from the mid-1950s to the late 1980s. Small spills or leaks may have occurred during its operation. In 1991 and 1992, a total of 42 cubic yards of soil was excavated from the site.

### **2.1.10 SS 004: Hazardous Waste Drum Storage Area**

SS 004 is located at the southwest corner of Building 923, north of the intersection of Andrews Road and 155th Street. The site is approximately 15,00 square feet in area. The site was used as a hazardous waste storage area from the 1960s to 1985. No hazardous materials have been stored in the area since 1985.

During its operation, it is likely that small spills or leaks occurred that contributed to contamination of surface soils. The volume of contaminated soil was estimated by the Air Force to be approximately 23 cubic yards. As a result, 15 cubic yards of contaminated soil was excavated from the hazardous waste storage area in 1991.

### **2.1.11 SS 006: Hazardous Material Storage Area**

SS 006 is located east of Building 927, east of Hanger Road, and north of 155th Street. Building 927 was used as an aircraft engine and propeller maintenance shop from 1957 to 1994. The area outside the rear of the building was used to keep bulk supplies of degreasers, solvents, and oils until needed inside. The materials were routinely stored in drums or other containers and placed off the ground on racks.

According to records, the grass immediately behind the storage racks was discolored and showed signs of stress. In 1993, approximately 40 cubic yards of contaminated soil were removed from SS 006.

### **2.1.12 SS 008: Test Cell Area**

SS 008 is located northeast of Building 973, southeast of Hangar Road. The area was used for aircraft maintenance from 1956 to 1977. Soaps, solvents, oils, and lubricants were used and stored at the site. After this designated use, waste materials were stored at the site for later disposal.

Small spills of fuel in and around the area have been suspected. A sheen of oil was observed on water that had seeped into low areas of the trench during a water line trench excavation project in 1991 by Air Force personnel.

### **2.1.13 SS 009: Fire Valve Area**

SS 009 is located directly behind Building 605. Building 605 was part of the Civil Engineering Complex and was in use from 1955 to 1997. The building is separated from the Fire Valve Area by a paved parking lot.

The site was identified in 1992 when petroleum product was detected during repairs to the fire hydrant. It was suspected that some waste materials might have been disposed of near the drainage swale adjacent to the Fire Valve Area.

### **2.1.14 ST 005: Petroleum, Oil, and Lubricants (POL) Storage Yard**

ST 005, the POL Yard, is a former aboveground tank farm located east of the flight line and west of Andrews Road. The POL Yard is about 12 acres in size and was operated between 1954 to 1988. The site was used to store and dispense JP-4 fuel, fuel oil, and motor gasoline. All of the structures formerly at the site have been removed except for two aboveground tanks. The POL Yard was decommissioned in 1996.

Petroleum contaminants have been detected in the site soils and groundwater, and several investigations have been conducted to evaluate the nature and extent of petroleum contamination.

### **2.1.15 ST 007: Former UST Area**

ST 007, a former UST site, is located at the Building 902 site, west of Hangar Road and north of 155th Street. From 1954 to 1977, the site was used as part of the main aircraft refueling station. Four USTs were located beneath Building 902. The tanks were abandoned in place in 1977 and removed in 1988. No hazardous materials have been stored in the area since 1977. The site occupies approximately 2,600 square feet in area and is now covered with a variety of vegetation.

No leaks were recorded during the fuel system's operational life. However, undetected spills or leaks may have occurred at the underground tanks and associated dispensing lines, resulting in contamination of subsurface soils. Discolored soils and petroleum odors were noticed during the 1988 excavation and removal of the four USTs.

### **2.1.16 XO 001: Belton Training Complex (BTC)**

XO 001 is located about four miles south of the Base. It has been traditionally used for military training exercises and consists of a 184-acre drop zone surrounded by a 287-acre safety easement. In 1970, the site was shut down and remained dormant until 1977. No hazardous materials have been stored in the area since mid-1980s.

During its operation, munitions and ordnance were routinely disposed of through burning. The remains of these fires have been noticed during several recent site inspections.

## **2.2 Description of Tasks**

Field tasks planned for the 16 sites at Richards-Gebaur AFB are described as follows.

### 2.2.1 AOC 001: Central Drainage Area

The primary COC at the Central Drainage Area are VOCs and metals. Both groups of chemicals have been detected in sediments collected from the drainage ditches. It should be noted, however, that much of the available site-specific data were J-qualified, indicating that the analytes were positively identified but the reported concentrations were estimated values.

The following field tasks are planned for AOC 001, Central Drainage Area:

- Collect nine surface water and sediment samples from the Central Drainage Area and analyze each sample for TPH, VOCs, and metals.

### 2.2.2 AOC 002: North Drainage Area

The COC at the North Drainage Area represent a variety of constituents that could become entrained in surface water runoff from the flightline and runways. Petroleum hydrocarbons, VOCs, SVOCs, and metals are COC at the site.

The following field tasks are planned for AOC 002, North Drainage Area:

- Measure groundwater level periodically for the existing well.
- Collect groundwater sample from the existing well. Analyze samples for PAH and TPH.
- Collect three surface water and sediment samples from the pond and analyze these samples for PAH and TPH.

### 2.2.3 AOC 003: Firing Range

The primary COC associated with the Firing Range site are metals that are routinely used in the manufacture of shot and other small arms munitions. A typical round of ammunition consists of a bullet or ball, a cartridge case that contains the propellant, and a cap with the ignition system. The bullets may come with or without a metal outer jacket. Copper and zinc could be released by the bullets.

The following field tasks are planned for AOC 003, Firing Range:

- Collect three surface water samples from the drainage ditch and analyze these samples for metal concentrations.

### 2.2.4 AOC 010: Building 918 Parking Lot

Potential COC at Building 918 Parking Lot site are those gasoline-range and diesel-range hydrocarbons routinely associated with jet fuel.

The following field tasks are planned for AOC 010, Building 918 Parking Lot:

- Measure groundwater level for one onsite piezometer to evaluate the occurrence of groundwater.
- Collect one groundwater sample from the existing piezometer and analyze it for VOCs and TPH

### 2.2.5 CS 001: Fuel Line – 942 Section

COC at CS 001 are TPH constituents and BTEX compounds. These chemicals are characteristic of petroleum fuel products.

The following field tasks are planned for CS 001, Fuel Line – 942 Section:

- Measure water level elevations periodically at each of the three existing monitoring wells and determine groundwater flow direction.
- Collect groundwater samples from each existing well and analyze the samples for VOCs and TPH constituents.
- Advance three soil borings immediately in front of the north wall of Building 942 (near where the steam line entered the building) to evaluate potential soil contamination under the building.
- Collect two soil samples from each boring and analyze the samples for TPH and VOCs.

### 2.2.6 CS 002: Oil / Water Separator at Building 704

The COC at CS 002 include TPH constituents, VOCs, and metals. Soil and groundwater samples have been collected to evaluate the extent and distribution of the chemicals at the site.

The following field tasks are planned for CS 002, Oil / Water Separator at Building 704:

- Install one groundwater monitoring well at the site.
- Measure groundwater levels in the new monitoring well and in two existing wells periodically to evaluate the groundwater flow direction and hydraulic gradient.
- Collect groundwater samples from the new well and from two existing wells. Analyze samples for TPH, VOCs, and metals.
- Collect soil samples from the monitoring well borehole and analyze the samples for TPH, VOCs, and metals.

### 2.2.7 CS 004: UST 620A

Potential COC at CS 004 are those gasoline-range and diesel-range hydrocarbons routinely associated with jet fuel.

The following field tasks are planned for CS 004, UST 620A:

- Install three groundwater monitoring wells at the site.
- Measure groundwater levels in the new monitoring wells periodically to evaluate the groundwater flow direction and hydraulic gradient
- Collect groundwater samples from each well and analyze the samples for TPH, VOCs, SVOCs, and metals.
- Collect soil samples from each well boring at a depth that corresponds to 12 inches below the invert of the former UST. Analyze soil samples for TPH, VOCs, SVOCs, and metals.

### 2.2.8 FT 002: North Burn Pit (FTA)

COC at FT 002 are those associated with waste oils, solvents, and fuels.

The following field tasks are planned for FT 002, North Burn Pit (FTA):

- Drill and sample three soil borings through the concrete pit to the top of bedrock. If groundwater is encountered, install one monitoring well.
- Collect additional soil samples at the former aboveground storage tank (AST) location and the former OWS location.
- Collect soil samples at 100-foot intervals along the length of product and dispensing lines, in accordance with MDNR UST closure guidelines.
- Analyze soil samples for TPH, VOCs, SVOCs, and lead.
- Periodically measure groundwater elevations in six monitoring wells to assess groundwater flow direction and hydraulic gradient.
- Collect groundwater samples from each monitoring well and analyze the samples for TPH, VOCs, SVOCs, and metals.
- Conduct geochemical analyses on select soil and groundwater samples to evaluate the potential for natural attenuation at the site.

### 2.2.9 SS 003: Oil Saturated Area

Potential COC at SS 003 include benzene, toluene, ethylbenzene, and xylene (BTEX) compounds, TPH constituents, PAH compounds, and metals.

The following field tasks are planned for 003, Oil Saturated Area:

- Install one additional groundwater monitoring well at the site.
- Continuously sample soils during well boring to evaluate geology and identify potential water-bearing zones.
- Periodically measure groundwater elevations at site wells to determine groundwater flow direction and hydraulic gradient.
- Collect groundwater samples from the three existing and one new monitoring well. Analyze the samples for TPH, VOCs, SVOCs, and metals.
- Conduct geochemical analyses on select soil and groundwater samples to evaluate the potential for natural attenuation at the site.

### 2.2.10 SS 004: Hazardous Waste Drum Storage Area

Potential COC at SS 004 are VOCs, SVOCs, TPH, and metals.

The following field tasks are planned for SS 004, Hazardous Waste Drum Storage Area:

- Install one additional groundwater monitoring well at the site.
- Continuously sample soils during well boring to evaluate geology and identify potential water bearing zones.



- Periodically measure groundwater elevations at site wells to determine groundwater flow direction and hydraulic gradient.
- Collect groundwater samples from the new monitoring well and from three existing wells. Analyze each of the samples for VOC, SVOC, TPH, and metals.
- Collect one soil sample and analyze the sample for VOC, SVOC, TPH, and metals.

### **2.2.11 SS 006: Hazardous Material Storage Area**

The COC at SS 006 include TPH, VOCs, and SVOCs, chemicals commonly associated with oils and solvents routinely used during engine and propeller maintenance and repairs.

The following field activities are planned at SS 006, Hazardous Material Storage Area:

- Install three additional monitoring wells.
- Continuously sample soils during well drilling to evaluate the site geology and identify potential water-bearing zones to ensure new wells monitor the appropriate strata.
- Periodically measure groundwater elevations at the site to evaluate groundwater flow direction and hydraulic gradient.
- Collect groundwater samples from three new wells and one existing well. Analyze samples for VOCs, SVOCs, and metals.
- Collect three soil samples and analyze the samples for VOC, SVOC, and metals.

### **2.2.12 SS 008: Test Cell Area**

Because of the widespread use of petroleum products and detergents in the past, and the reported storage of used oil and other waste liquids, several COC are potentially related to the former Test Cell Area. These chemicals include TPH constituents, VOCs, SVOCs, and metals.

The following field activities are planned for SS 008, Test Cell Area:

- Install one groundwater monitoring well at the location of suspected petroleum contamination.
- Periodically measure groundwater elevations at the site to evaluate groundwater flow direction and hydraulic gradient.
- Collect a groundwater sample from the new monitoring well and analyze it for TPH and SVOCs.
- Collect three soil samples and analyze the samples for TPH and SVOCs.

### **2.2.13 SS 009: Fire Valve Area**

The COC at SS 009 are petroleum hydrocarbons and chlorinated hydrocarbons.

The following tasks are planned for SS 009, Fire Valve Area:

- Install three groundwater monitoring wells to bedrock around the perimeter of the site to assess current groundwater quality conditions.

- Periodically measure groundwater elevations to evaluate groundwater flow direction and hydraulic gradient.
- Collect groundwater samples from each of the three new wells. Analyze the samples for TPH, VOCs, PCBs and metals.
- Continuously sample soils during well drilling to evaluate the site geology and identify potential water-bearing zones.
- Collect three soil samples and analyzed them for TPH, VOCs, PCBs, and metals.
- Conduct geochemical analyses on select soil and groundwater samples to evaluate the potential for natural attenuation at the site.

#### **2.2.14 ST 005: Petroleum, Oil, and Lubricants (POL) Storage Yard**

The POL Yard stored and distributed petroleum fuel products. The COC, therefore, are those chemicals commonly associated with fuel depots: TPH constituents, BTEX, PAH, and lead.

The following field tasks are planned for ST 005, POL Yard:

- Collect one round of groundwater samples from all POL Yard monitoring wells; analyze the samples for TPH, VOCs, SVOCs, and metals.
- Periodically measure groundwater elevations to determine groundwater flow direction and hydraulic gradient.
- Drill and continuously sample four soil borings in the area of MW-3D to evaluate the vertical and lateral extent of petroleum hydrocarbons at this location and to identify any water-bearing zones.
- Collect soil samples from soil borings and analyze the samples for TPH and SVOCs.
- Conduct geochemical analyses on select soil and groundwater samples to evaluate the potential for natural attenuation at the site.

#### **2.2.15 ST 007: Former UST Area**

Potential COC at ST 007 are BTEX, TPH constituents, and PAH compounds.

The following field tasks are planned for ST 007, Former UST Area:

- Periodically measure groundwater elevations to evaluate groundwater flow direction and hydraulic gradient.
- Collect groundwater samples from the existing monitor wells and analyze the samples for VOCs, TPH, and SVOCs.
- Drill six additional soil borings and collect continuous soil samples to delineate the extent of contamination. Analyze the soil samples from each boring for VOCs, TPH, and SVOCs.

### 2.2.16 XO 001: Belton Training Complex (BTC)

Because of the site's use as a drop zone and ordinance disposal area, the COC are considered to be those commonly associated with explosives, petroleum products, and metals.

The following field tasks are planned for XO 001, BTC:

- Install eight monitoring wells at the site.
- Collect groundwater samples from each monitoring well. Analyze these samples for TPH and metals.
- Collect background samples of soil, sediment, surface water, and groundwater and compare these data with existing levels of metals detected in site media during earlier site investigations.
- Continuously sample soils during well drilling to evaluate the site geology and identify potential water-bearing zones.
- Periodically measure depth to groundwater to evaluate groundwater flow direction and hydraulic gradient.
- Collect additional surface water and sediment samples to evaluate extent of metals and to compare with site-specific background data.

## 3.0 Organization

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The Field Team Leader/SSC communicates to the Project Manager and Health and Safety Manager. The Project Manager is responsible for communicating with the client.

### 3.1 Client

Team Chief	Kay Grosinske	(210) 536-6451
Contracting Specialist	Jill Benefield	(210) 536-4484

### 3.2 CH2M HILL

Project Manager	Peter Barrett/St. Louis, MO	(314) 421-0313 ext. 241
Health and Safety Manager	Richard Rathnow/Milwaukee, MO	(414) 272-1052 ext. 376
Site Safety Coordinator (SSC)	Chris English/STL	(314) 421-0313 ext. 221

### 3.3 Subcontractor

When specified in the project documents (e.g., contract), this plan may cover those subcontractors contracted with CH2M HILL. However, this plan does not address hazards specific to specialty subcontractor's work (e.g., drill rig safety as it applies to the operation of the rig). The specialty subcontractor is responsible for health and safety procedures and plans specific to their work. Subcontractors must comply with an established HSP; CH2M HILL must monitor and enforce compliance with the established plan.

#### Subcontractors

- Drilling Subcontractor: Layne-Western
 

Address	620 South 38 <sup>th</sup> Street, Kansas City, KS 66106
Contact Person	Nate Baldwin
Phone Number	(913) 321-5000
- Laboratory Subcontractor: Columbia Analytical Services
 

Address	5090 Caterpillar Road, Redding, CA 96003
Contact Person	Ed Wilson
Phone Number	(530) 244 -5227
- Investigation-Derived Waste Disposal Subcontractor: Geotechnical Services Inc.
 

Address	8400 East 13 <sup>th</sup> Terrace, Kansas City, Missouri 64126
Phone Number	(816) 461-1205

General health and safety communications with subcontractors contracted with CH2M HILL and covered by this plan mandate that CH2M HILL perform the following:

- Brief subcontractor employees on this plan.
- Direct health and safety communications to a subcontractor-designated representative.

- Notify the subcontractor-designated representative if an apparent hazard (e.g., violation of established plan) is observed. Specialty subcontractors are responsible for mitigating hazards (e.g., a drill rig safety hazard).
- Warn subcontractor if a hazard condition persists. Stop work affected by hazard, and as a last resort, if hazard is not eliminated, notify the Project Manager.
- Promptly remove all affected personnel when an apparent imminent danger exists. Notify the Project Manager.
- Make clear that consistent violations of the HSP by a subcontractor may result in termination of the subcontract.

### 3.4 Contractor

This plan does not cover contractors contracted directly to the Air Force. CH2M HILL is not responsible for directing contractor personnel and does not assume responsibility for their actions.

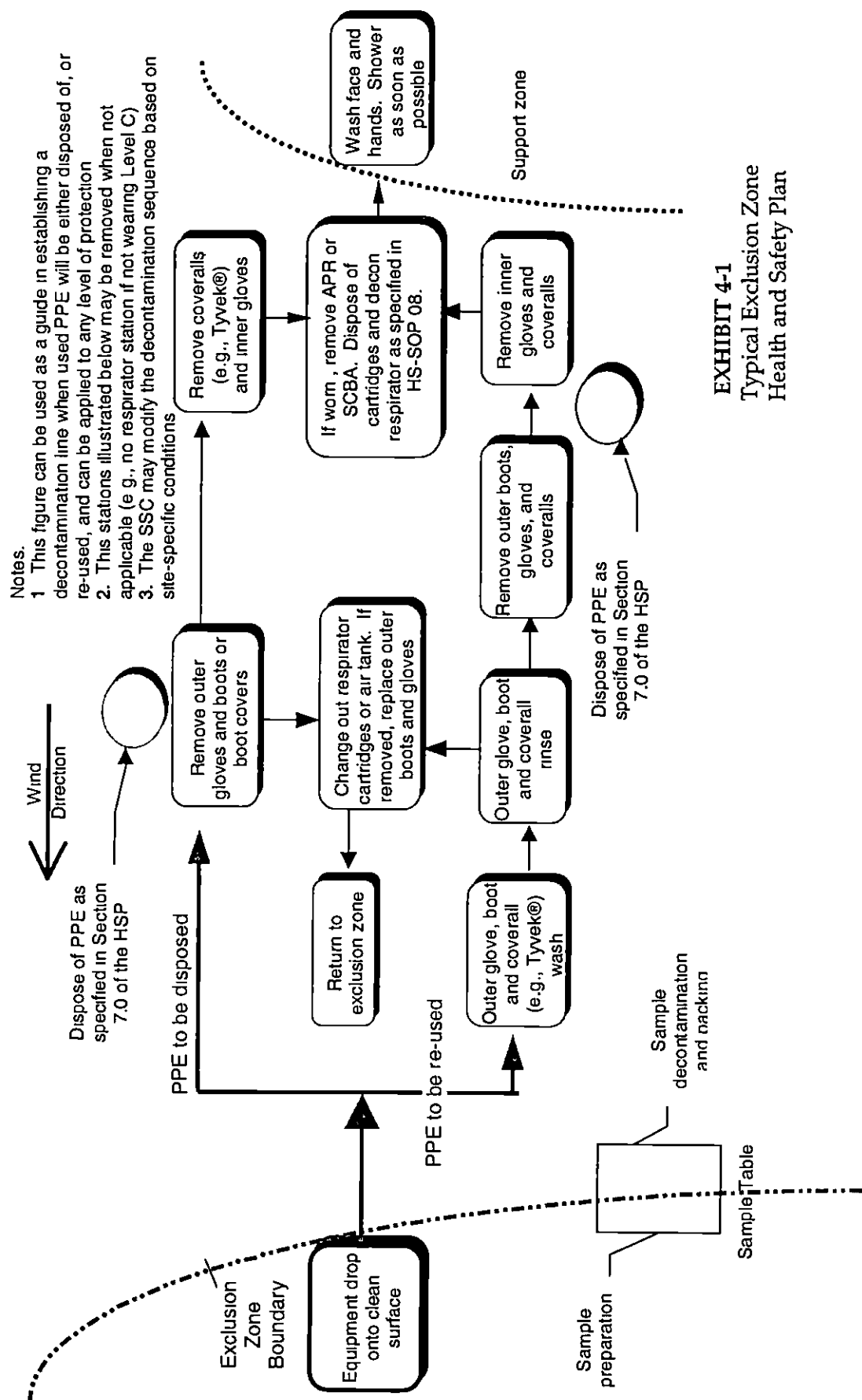
General health and safety communications with contractors *not* contracted with CH2M HILL are listed below. These procedures can also be applied to other third party communications (e.g., client personnel). To facilitate this communication, CH2M HILL will perform the following:

- Ask the contractor to brief CH2M HILL on the contractor's health and safety plan, including how the plan affects CH2M HILL personnel at the site. The contractor will furnish a copy of the contractor's health and safety plan to CH2M HILL.
- If acceptable to the client, communicate about health and safety directly with the contractor's project manager or other contractor-designated representative. CH2M HILL personnel are not to direct the details of the contractor's work or to advise on health and safety (e.g., how the contractor corrects unsafe conditions).
- Notify the party controlling the work activity as soon as possible if an observed hazard poses a risk to CH2M HILL personnel. Notify the Project Manager; the Project Manager will notify the client. Document any oral notification in the project records (e.g., the field logbook).
- If a hazardous condition endangering CH2M HILL personnel persists, inform the contractor and the Project Manager (the Project Manager will notify the client) that CH2M HILL cannot execute the assigned work until the hazard is mitigated.
- When an apparent imminent danger exists, orally warn the person(s) in danger and orally notify the contractor promptly. When an imminent danger involves a CH2M HILL employee, remove the employee and suspend CH2M HILL work immediately until the hazard has been mitigated. Inform the Project Manager and the contractor promptly.
- The SSC or the Project Manager must notify the client and CH2M HILL health and safety staff when (1) the contractor fails to remedy an unsafe condition affecting CH2M HILL personnel; (2) the contractor does not remedy the hazardous condition within a reasonable period of time; or (3) the contractor repeatedly creates the hazardous condition.

## 4.0 Site Map

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It is anticipated that all site work will be conducted using Level D personal protective equipment. An exclusion zone, decontamination zone, and support zone will be set up at a pre-determined staging location for level C work should this be required. Level B work is not expected during the RI investigation. **Exhibit 4-1** provides an example of a site control layout.



## 5.0 Hazard Analysis

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### 5.1 Heat Stress (REFERENCE CH2M HILL SOP HS-09)

To avoid hazardous situations and mitigate hazardous circumstances, all personnel should follow the procedures and guidelines detailed below.

The SSC can help prevent heat stress by:

- Supplying at least 16 ounces of water before personnel begin work (e.g., in the morning or after lunch). Disposable 4-ounce cups and water maintained at 50°F to 60°F should be available.
- Providing adequate shelter to protect personnel against heat. The heat can decrease physical efficiency and increase the probability of heat stress.
- Rotating shifts of workers in hot weather.
- Informing personnel of the following guidelines and appropriate procedures for avoiding heat stress:
  - Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Personnel should also take regular breaks in a cool, preferably air-conditioned area. Alcohol or other non-alcoholic fluids should not be used instead of water, and coffee intake should be decreased. Personnel should monitor themselves for signs of heat stress.
  - Acclimate to site work conditions by slowly increasing workloads (e.g., do not begin site work with extremely demanding activities).
  - Use cooling devices, such as cooling vests, to aid natural body ventilation. Note that these devices add weight, and their use should be balanced against efficiency.
  - Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
  - During hot weather, conduct field activities in the early morning or evening, if possible.
  - Maintain good hygiene standards by frequently changing clothes and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should consult medical personnel.

**Exhibit 5-1** presents some of the symptoms, treatments, and prevention measures for heat-related stress.



**EXHIBIT 5-1****Symptoms and Treatment of Heat Stress**  
*Health and Safety Plan*

<b>Heat Disorder</b>	<b>Signs/Symptoms</b>	<b>Treatment</b>	<b>Prevention Measures</b>
Heat Syncope	Sluggishness or fainting while standing erect or immobile in heat.	Remove to cooler area Rest in recumbent position. Increase fluid intake.	Acclimatization and intermittent activity (see below under "heat stroke").
Heat Rash (miliaria rubra; "prickly heat")	Profuse, tiny, raised, red, blister-like vesicles on affected areas, with pricking sensations during heat exposure.	Mild drying lotions, powders, and skin cleanliness to dry skin and prevent infection.	Allow skin to dry between heat exposures
Heat Cramps	Painful spasms of muscles used during work (arms, legs, or abdomen); onset during or after work	Remove to cooler area. Rest in recumbent position. Increase fluid intake.	Acclimatization and intermittent activity (see below under "heat stroke").
Heat Exhaustion	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or hectic flush; may faint on standing, with rapid thready pulse and low blood pressure; oral temperature normal or low	Remove to cooler area Rest in recumbent position with head in low position. Administer fluids by mouth. Seek medical attention	Acclimatization and intermittent activity (see below under "heat stroke").
Heat Stroke	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.	Cool rapidly by soaking in cool (not cold) water. Call ambulance and get medical attention immediately!	Acclimatize workers using an intermittent break-in schedule for 5 to 7 days, with plenty of rest periods. Ample drinking water must be available at all times and taken frequently during the workday.

**5.2 Cold Stress** (REFERENCE CH2M HILL SOP HS-09)

The SSC can help prevent cold stress by informing personnel of the following guidelines:

- Be aware of symptoms of cold-related disorders and wear proper clothing for the expected field work.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC), both of which can be found in CH2M HILL SOP HS-09.
  - **Wind-chill Index.** This measure relates the dry bulb temperature and the wind velocity. It is used only to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index is sometimes limited in its usefulness because the index does not consider the body part that is exposed, the level of activity, or the amount or type of clothing worn. For this reason, it is used only as a guideline to warn workers when they are in a situation that can cause

cold-related illnesses. Used in conjunction with the NSC guidelines, the wind-chill index provides a starting point for adjusting work and warm-up schedules.

- **NSC Work/Warm-up Schedule Guidelines.** The cold exposure limits recommended by the NSC can be used in conjunction with the wind-chill index to estimate a work and warm-up schedule for field work. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illness. If symptoms are not observed, the work interval can be increased.

**Exhibit 5-2** presents some of the symptoms and treatments for cold-related stress, such as immersion foot, frostbite, and hypothermia.

**EXHIBIT 5-2**  
Symptoms and Treatment of Cold Stress  
*Health and Safety Plan*

Cold Disorder	Signs/Symptoms	Treatment
Frostbite	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Remove victim to a warm place. Re-warm area quickly in warm (not hot) water. Have victim drink warm fluids – not coffee or alcohol. Do not break any blisters. Elevate the injured area and seek medical attention.
Immersion (Trench) Foot	Feet discolored and painful, infection and swelling present.	Seek medical attention immediately.
Hypothermia	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse, slow respiration.	Remove victim to a warm place. Have victim drink warm fluids – not coffee or alcohol. Seek medical attention.

## 5.3 Physical (Safety) Hazards and Controls (REFERENCE CH2M HILL SOP HS-03)

Engineering and administrative controls are generally to be implemented by the party in control of the site or hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees must, at a minimum, remain aware of hazards affecting them, regardless of who is responsible for controlling the hazards.

**Exhibit 5-3** describes the hazards that may be present at the work site and provides information on how personnel are to protect themselves from each hazard. The SSC will verify that the control measures included in this table are implemented as appropriate during site activities.

EXHIBIT 5-3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drilling, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.										
Tasks										
Hazard	Engineering Controls, Administrative Controls, and Work Practices	Excavation	Drilling, Well Installation and Abandonment	Groundwater Monitoring	Surface Water and Sediment Sampling from Water	Hand Augering	Surveying	IDW Drum Sampling and Disposal <sup>a</sup>	Observation of Loading of Material for Offsite Disposal	Remediation and Construction Oversight
Flying debris/objects (HS-07)	Provide shielding and PPE, maintain distance.		X		X	X		X	X	X
Noise > 85 dBA	Noise protection and monitoring required.		X						X	X
Gas cylinders (HS-21)	Instruct employees in the safe use of compressed gases. Make certain gas cylinders are properly anchored and chained. Keep cylinders away from ignition sources. Cap cylinders when not in use.		X							
Electrical	Make certain third wire is properly grounded. Do not tamper with electrical wiring unless qualified to do so. Ground as appropriate.									
	Project field sites should have ground fault circuit interrupters (GFCIs) installed for all wiring, including extension cords.									
	Heavy equipment (e.g., drilling) should remain at least 15 feet from overhead power line for power lines of 50 kV or less. For each 10 kV > 50, increase distance by ½ foot.									
	Operate and maintain equipment according to manufacturer's instructions.		X	X						X
	Use only extension cords that are three-wire grounded. Cords passing through work areas must be covered or elevated to protect from damage.									
Suspended loads	Use only electrical tools and equipment that are either effectively grounded or double-insulated UL approved.									
	Properly label switches, fuses, and circuit breakers.									
	Remove cord from an outlet by grasping the plug, not pulling the cord.									
	Protect all electrical equipment, tools, switches, etc., from elements.									
	Avoid physical contact with power circuit.									
Buried utilities, drums, tanks, etc. (Section 3.3)	Only qualified electricians are to install and work on electrical circuits and equipment.									
	Work not permitted under suspended loads.		X						X	X
	Locate buried utilities, drums, tanks, etc., before digging or drilling and mark location.		X			X				X
	Provide slip-resistant surfaces, ropes, and/or other devices to be used. Brace and shore equipment.		X	X	X	X	X	X	X	X
	Slip, trip, fall hazards (e.g., wet/muddy surface, inadequate railing, unstable surface)									

EXHIBIT 5-3											
GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS											
Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specially subcontractors are responsible for the safe operation of their equipment (e.g., drilling, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment											
Tasks											
Hazard	Engineering Controls, Administrative Controls, and Work Practices	Excavation	Drilling, , Well Installation and Abandonment	Groundwater Monitoring	Surface Water and Sediment Sampling from Water	Hand Augering	Surveying	IDW Drum Sampling and Disposal <sup>a</sup>	Observation of Loading of Material for Offsite Disposal	Remediation and Construction Oversight	
Back injury (HS-29)	Use proper lifting techniques, or provide mechanical lifting aids		X	X	X	X		X			
Trenches/excavations (HS-32)	Make certain trench meets OSHA standard before entering. All excavations > 4 feet deep must be sloped or shored and have a ladder every 25 feet. Personnel and equipment must remain at least 2 feet from edge of trench at all times.										
Protruding objects	Flag visible objects		X	X	X	X	X	X	X		
Visible lightning	Stop work		X	X	X	X	X	X	X		
Vehicle traffic (HS-24)	Provide temporary traffic controls, including trained flaggers and lookouts. Implement traffic control program when required								X		
Elevated work area/falls (HS-31)	Provide guardrail, safety net, floor covers, body harness, and monitoring system, where applicable. Document employee training				X						
Fire prevention and control (HS-22)	No spark sources are allowed within exclusion or decontamination zones.  Appropriate firefighting equipment must be available on the site.  Extinguishers are to be inspected visually every month and undergo an annual maintenance check.  Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations. Keep areas near exits and extinguishers clear. Open flames are prohibited in the vicinity of flammable materials.  Combustible materials stored outside should be at least 10 feet from the building.  Unnecessary combustible materials and flammable or combustible liquids must not be allowed to accumulate.  Flammable or combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.		X		X			X			
Inadequate illumination	Site work will be performed during daylight hours whenever possible. Work conducted during hours of darkness will require enough illumination intensity "to read a newspaper without difficulty."		X	X	X	X	X	X	X		
Entanglement in rotating equipment	Prohibit loose clothing and hair		X			X					

EXHIBIT 5-3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor) CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drill rig, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment										
Tasks										
Hazard	Engineering Controls, Administrative Controls, and Work Practices	Excavation	Drilling, , Well Installation and Abandonment	Groundwater Monitoring	Surface Water and Sediment Sampling from Water	Hand Augering	Surveying	IDW Drum Sampling and Disposal <sup>a</sup>	Observation of Loading of Material for Offsite Disposal	Remediation and Construction Oversight
Drilling	Prohibit wearing jewelry									
	The drill rig is not to be operated in inclement weather The driller is to verify that the rig is properly leveled and stabilized before raising the mast. Personnel should be cleared from the sides and rear of the rig before the mast is raised. The driller is not to drive the rig with the mast in the raised position The driller must check for overhead power lines before raising the mast. A minimum distance of 15 feet between mast and overhead lines (<50 kV) is recommended. Increased separation may be required for lines greater than 50 kV. Personnel should stand clear before rig startup The driller is to verify that the rig is in neutral when the operator is not at the controls Become familiar with the hazards associated with the drilling method used (cable tool, air rotary, hollow-stem auger, etc.). Do not wear loose-fitting clothing, watches, etc., that could get caught in moving parts. Do not smoke or permit other spark-producing equipment around the drill rig The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location. Be aware and stand clear of heavy objects that are hoisted overhead. The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program. The driller is to verify that all machine guards are in place while the rig is in operation The driller is responsible for housekeeping (maintaining a clean work area). The drill rig should be equipped with at least one fire extinguisher. If the drill rig comes into contact with electrical wires and becomes									

EXHIBIT 5-3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drill rig, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.										
Tasks										
Hazard	Engineering Controls, Administrative Controls, and Work Practices	Excavation	Drilling, Well Installation and Abandonment	Groundwater Monitoring	Surface Water and Sediment Sampling from Water	Hand Augering	Surveying	IDW Drum Sampling and Disposal <sup>a</sup>	Observation of Loading of Material for Offsite Disposal	Remediation and Construction Oversight
	electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately									
Heavy equipment	Become familiar with hazards specific to the equipment being used. Always confirm that the operator is aware of your location, particularly when you approach or pass by equipment Backup alarm is required for heavy equipment. Do not count on backup alarms always functioning. Look around when alarm sounds. Do not ride equipment not designed for passengers Do not climb on operating equipment. Do not place yourself between fixed and moving parts or objects. Do not stand adjacent to the equipment Stay clear of equipment on cross slopes and unstable terrain. Stay clear of pile-driving operations Stay outside the turning radius of the equipment. Operators using all-terrain vehicles (ATV) must be trained, other ATV requirements may apply Observer must remain in contact with operator and signal safe backup. Personnel must remain outside the turning radius.	X	X						X	
Working near water	U.S. Coast Guard-approved personal flotation devices (PFDs—e.g., life jacket) provided for each employee will be worn. PFDs will be inspected before and after each use. Defective equipment will not be used. Sampling and other equipment will be used according to the manufacturer's instructions A minimum of one life-saving skill will be provided for emergency rescue. A minimum of one ring buoy with 90 feet of 3/8-inch solid-braid polypropylene (or equal) rope will be provided for emergency rescue				X					

EXHIBIT 5-3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drilling, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.											
Tasks											
Hazard	Engineering Controls, Administrative Controls, and Work Practices	Excavation	Drilling, , Well Installation and Abandonment	Groundwater Monitoring	Surface Water and Sediment Sampling from Water	Hand Augering	Surveying	IDW Drum Sampling and Disposal <sup>a</sup>	Observation of Loading of Material for Offsite Disposal	Remediation and Construction Oversight	
IDW Drum sampling	Keep nonessential personnel 3 feet from edge of water										
	Personnel are allowed to handle and/or sample drums containing investigation-derived waste (IDW) only, handling or sampling other drums requires a plan revision or amendment approved by the CH2M HILL HSM. The following control measures will be taken when sampling drums containing IDW:  Minimize transportation of drums Minimize number of people involved in the actual sampling. Sample only labeled drums or drums known to contain IDW Use caution when sampling bulging or swollen drums. Relieve pressure slowly. If drums contain, or potentially contain, flammable materials use nonsparking tools to open Picks, chisels, and firearms may not be used to open drums. Reseal bung holes or plugs whenever possible. Avoid mixing incompatible drum contents. Sample drums without leaning over the drum opening. If there is evidence of contamination on the lid of the drum, cover the lid with plastic sheeting Transfer the content of drums using a method that minimizes contact with material. Air monitoring and PPE requirements specified in sections 5 and 6 must address drum sampling Spill-containment procedures specified in Section 8 must be appropriate for the material to be handled.						X				

## 5.4 Procedures to Locate Buried Utilities

Buried utilities will be located and clearly marked at each site before drilling operations begin. CH2M HILL will contact Missouri's Utility Mark-Out Hotline (800 344-7438) and the responsible onsite parties.

Where available, CH2M HILL will obtain utility diagrams for the facility. Locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines will be reviewed, based on information provided by Mr. Dave Malecki (Manager for Richards-Gebaur Airport). Where there is uncertainty about utility locations, drilling of the upper depth interval shall be performed manually. CH2M HILL and the drilling subcontractor will monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon).

## 5.5 Biological Hazards and Controls

**Exhibit 5-4** presents measures the SSC and personnel should take for biological hazards such as snakes, poisonous plants, bloodborne pathogens, and stinging insects.

### EXHIBIT 5-4

#### Biological Hazards and Controls Health and Safety Plan

Hazard and Location	Control Measures
<b>Snakes</b> typically are found in underbrush and tall grassy areas.	<p>If you encounter a snake, stay calm and look around, there may be other snakes. Turn around and walk away on the same path you used to approach the area.</p> <p>If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. DO NOT apply ice, cut the wound, or apply a tourniquet. Carry the victim or have him/her walk slowly if the victim must be moved. Try to identify the type of snake, note color, size, patterns, and markings.</p>
<b>Poison ivy, poison oak, and poison sumac</b> typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas.	<p>Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.</p>
Exposure to <b>bloodborne pathogens</b> may occur when rendering first aid or CPR, or when coming into contact with medical or other potentially infectious material, or when coming into contact with landfill waste or waste streams containing such infectious material.	<p>Training is required before a task involving potential exposure is performed. Exposure controls and PPE are required as specified in CH2M HILL SOP HS-36, <i>Bloodborne Pathogens</i>. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.</p>
<b>Bees and other stinging insects</b> may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic.	<p>Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or the buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction, seek medical attention if a reaction develops.</p>



## 5.6 Tick Bites, Lyme Disease, and Rocky Mountain Spotted Fever (RMSF)

Many sites contain ticks capable of carrying fatal diseases, specifically Lyme disease and Rocky Mountain Spotted Fever (RMSF). The SSC should inform his or her personnel of prevention techniques necessary to help avoid tick bites and treatment methods should bites occur, as detailed in **Exhibit 5-5**.

### EXHIBIT 5-5

#### Tick Prevention and Treatment Measures *Health and Safety Plan*

Frequent Location	Prevention Measures)	Treatment
Ticks typically can be found in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size.	Avoid tick areas; wear tightly woven, light-colored clothing with long sleeves and tucking pant legs into boots or socks; spray <b>only outside</b> of clothing with insect repellent containing permethrin or permethrin, and spray skin with DEET, check frequently for ticks, and shower as soon as possible. To prevent chemical repellents from interfering with sample analyses, exercise care while using repellents during the collection and handling of environmental samples.	<b>If bitten</b> by a tick, carefully remove the tick with tweezers, grasping the tick as close as possible to the point of attachment while being careful not to crush the tick. After removing the tick, wash your hands and disinfect and press the bite area. The removed tick should be saved. Report the bite to human resources personnel.  Look for symptoms of Lyme disease or RMSF. Lyme a rash that looks like a bullseye with a small welt in the center. RMSF. a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, bone pain may develop. If symptoms appear, seek medical attention.

## 5.7 Radiological Hazards and Controls

Not applicable.

## 5.8 Hazards Posed by Chemicals Brought Onsite

For details about chemical hazards, the SSC should refer to the CH2M HILL *Hazard Communication Program Manual*, which is available from the Corporate Human Resources Department in Denver. The Project Manager is to request Material Safety Data Sheets (MSDSs) from the vendors and subcontractors for chemicals that CH2M HILL employees are potentially exposed to.

**Exhibit 5-6** presents a list of chemicals that may be brought onsite. Additional chemicals will be maintained by the SSC in the field trailer. The SSC is responsible for ensuring that all chemicals used by field crews are inventoried and properly labeled. The SSC is also responsible for maintaining the appropriate MSDSs.

**EXHIBIT 5-6**  
**Chemicals That May Be Brought Onsite**  
*Health and Safety Plan*

<b>Chemical</b>	<b>Location(s)</b>
Isobutylene	Support Zone
Methane	Support Zone
Hydrochloric Acid	Exclusion Zone
Nitric Acid	Exclusion Zone
Hexane	Support / Decontamination Zones
Methanol	Support / Decontamination Zones
Hydrogen	Support / Exclusion Zones
pH Buffer Solutions	Support Zone
Conductivity Solutions	Support Zone

## 5.9 Contaminants of Concern

Exhibit 5-7 summarizes the contaminants of concern for the sites at Richards-Gebaur AFB.

**EXHIBIT 5-7****Contaminants of Concern***Health and Safety Plan*

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum <sup>a</sup> Concentration (ppm)	Exposure Limit <sup>b</sup>	IDLH <sup>c</sup>	Symptoms and Effects of Exposure	PIP <sup>d</sup> (eV)
Arsenic	Soil: 21.7 (CS 004)	0.01 mg/m <sup>3</sup>	5 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Barium	Soil: 8490 (CS 004)				
Benzene		1 ppm	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
Benzo(a) pyrene (as Coal Tar Pitch Volatiles-CTPV)	Soil: 66 (ST 005) Sed: 14 (AOC 002)	0.2 mg/m <sup>3</sup>	80 Ca	Dermatitis and bronchitis	N/A
Benzo(a)anthracene (as Coal Tar Pitch Volatiles-CTPV)	Soil: 14 (ST 005) Sed: 9.4 (AOC 002)	0.2 mg/m <sup>3</sup>	80 Ca	Dermatitis and bronchitis	N/A
Benzo(b)fluoranthene (as Coal Tar Pitch Volatiles-CTPV)	Soil: 6.6 (ST 005) Sed: 24 (AOC 002)	0.2 mg/m <sup>3</sup>	80 Ca	Dermatitis and bronchitis	N/A
Benzo(k)fluoranthene (as Coal Tar Pitch Volatiles-CTPV)	Sed: 17 (AOC 002)	0.2 mg/m <sup>3</sup>	80 Ca	Dermatitis and bronchitis	N/A
Beryllium	Sed: 18 (XO 001)	0.002 mg/m <sup>3</sup>	4 mg/m <sup>3</sup>	A confirmed lung carcinogen. Anorexia, low-weight weakness, chest pain, coughing and irritation of eyes and skin.	N/A
Cadmium	Sed: 64 (AOC 001)	0.005 mg/m <sup>3</sup>	9 Ca	Pulmonary edema, coughing, chest tightness/pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, difficulty breathing, loss of sense of smell, emphysema, mild anemia	NA

**EXHIBIT 5-7****Contaminants of Concern***Health and Safety Plan*

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum Concentration (ppm)	Exposure Limit <sup>b</sup>	IDLH <sup>c</sup>	Symptoms and Effects of Exposure	PIP <sup>d</sup> (eV)
Chrysene (as Coal Tar Pitch Volatiles-CTPV)	Sed: 20 (AOC 002)	0.2 mg/m <sup>3</sup>	80 Ca	Dermatitis and bronchitis	N/A
Dibenzo(a,h)anthracene (as Coal Tar Pitch Volatiles-CTPV)	Soil: 3.6 (ST 005)	0.2 mg/m <sup>3</sup>	80 Ca	Dermatitis and bronchitis	N/A
Indeno(1,2,3-c,d)pyrene (as Coal Tar Pitch Volatiles-CTPV)	Soil: 15 (ST 005) Sed: 11 (AOC 002)	0.2 mg/m <sup>3</sup>	80 Ca	Dermatitis and bronchitis	N/A
Ethyl Benzene		100 ppm	800	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcotic; coma	8.76
Lead	Soil: 924 (AOC 003) Sed: 670 (AOC 001)	0.05 mg/m <sup>3</sup>	100	Weakness, lassitude, facial pallor, pale eye, weight loss, malnutrition, abdominal pain, constipation, anemia, gingival lead line, tremors, paralysis of wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension	NA
Manganese	Sed: 16000 (AOC 001)	0.2 mg/m <sup>3</sup>	500 mg/m <sup>3</sup>	Parkinson's, insomnia, mental confusion, cough, chest tightness, vomiting, fatigue and kidney damage	N/A
Toluene		50 ppm	500	Eye and nose irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, excessive tearing, nervousness, muscle fatigue, paresthesia, dermatitis, liver and kidney damage	8.82
TPH (as BTEX)	Soil: 8568 (ST 005) Sed: 935 (AOC 002)	varies		CNS depression	N/A
Xylenes		100 ppm	900	Irritated eyes, skin, nose, and throat; dizziness, excitement; drowsiness, incoherence; staggering gait, corneal vacuolization, anorexia, nausea; vomiting; abdominal pain; dermatitis	8.56

**EXHIBIT 5-7****Contaminants of Concern***Health and Safety Plan*

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum <sup>a</sup> Concentration (ppm)	Exposure Limit <sup>b</sup>	IDLH <sup>c</sup>	Symptoms and Effects of Exposure	PIP <sup>d</sup> (eV)
Vinyl Chloride	Sed: 0.56 (AOC 001)	1 ppm	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9 99

**Footnotes:**<sup>a</sup> Specify sample-designation and media Sed sediment<sup>b</sup> Appropriate value of PEL, REL, or TLV listed<sup>c</sup> IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant), NL = No limit found in reference materials, CA = Potential occupational carcinogen<sup>d</sup> PIP = photoionization potential, NA = Not applicable, UK = Unknown**Potential Routes of Exposure**

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).
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## **5.10 Shipping and Transportation of Hazardous Products**

Nearly all chemicals brought onsite are considered hazardous materials by the U.S. Department of Transportation (DOT). All CH2M HILL personnel who ship the materials or transport them by road must receive the CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained personnel. For additional information, contact the Health and Safety Manager or the Equipment Coordinator.

## 6.0 Site Worker Training

### (REFERENCE CH2M HILL SOPs HS-01 AND HS-02)

Employees listed in **Exhibit 6-1** are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet the medical surveillance, 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training requirements of OSHA 29CFR1910.120. Employees designated SSC have received 8 hours of supervisor training and 4 hours of instrument training, and can serve as SSC for the level of protection indicated. One SSC must be present during any task performed in exclusion or decontamination zones that presents the potential for exposure to safety and health hazards.

Employees designated "First Aid-Cardiopulmonary Resuscitation (FA-CPR)" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. There must be one FA-CPR designated employee present during any task performed in exclusion or decontamination zones that presents the potential for exposure to safety and health hazards. The "buddy system" requirements of OSHA 29CFR1910.120 are to be met at all times.

The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees will inform the Field Team Leader of their pregnancy and will follow the procedures in CH2M HILL SOP HS-04, *Reproduction Protection*. Before being assigned field work, procedures require that pregnant employees obtain a physician's statement of the employee's ability to perform hazardous activities.

#### EXHIBIT 6-1

Project Team Members Enrolled in the CH2M HILL Comprehensive Health and Safety Program  
*Health and Safety Plan*

Employee	Office	Responsibility	SSC / FA-CPR
Peter Barrett	STL	Project Manager	FA-CPR
Chris English	STL	Field Team Leader / Site Safety Coordinator	Level D SSC, FA-CPR
Ning Li	STL	Field Team Member	Level D SSC, FA-CPR
Brad Klein	STL	Field Team Member	Level D SSC, FA-CPR
Anne Bartin	STL	Field Team Member	
Steve Bruer	STL	Field Team Member	Level D SSC, FA-CPR
Julie Mottin	STL	Field Team Member	

Additional personnel from various offices may participate in field activities. Names of these additional personnel must be incorporated into this plan. Employees signing Attachment 1 of this plan are considered to be incorporated into the plan, provided that the attachment is

maintained as part of the field office copy. A new Attachment 1 will be initiated before each major sampling event and when key personnel are added. The training status of employees must be reviewed and kept current.

During site work, a Level D SSC must be present. If an upgrade to a higher level of protection is required, an SSC who meets the upgrade level will be consulted. If necessary, the higher level SSC will come to the site.



## 7.0 Personal Protective Equipment

### 7.1 Personal Protective Equipment (REFERENCE CH2M HILL SOPs HS-07 AND HS-08)

**Exhibit 7-1** presents the types of PPE that must be worn when conducting Level C and Level D tasks.

**EXHIBIT 7-1**  
Personal Protective Equipment  
*Health and Safety Plan*

Task	Level	PPE <sup>a</sup>		
		Body	Head	Respirator
General work uniform when no chemical exposure is anticipated (e.g., surveying and site restoration activities)	D	Work clothes; steel-toed leather work boots; work gloves	Hardhat <sup>b</sup> , safety glasses, ear protection <sup>c</sup>	None required
Groundwater sampling, water level measurements; decontamination, Soil borings, sampling and groundwater well installation	Modified D	Work clothes; steel-toed leather work boots; inner nitrile surgical gloves and outer nitrile surgical gloves or chemical-resistant nitrile gloves  If air monitoring instrument indicates > 10 ppm in the work area, upgrade PPE to tyvek coveralls, chemical-resistant boots, and chemical-resistant gloves	Hardhat <sup>b</sup> , splash-shield, safety glasses; ear protection <sup>c</sup>	None required
Tasks requiring upgrade of PPE	C	Uncoated tyvek, steel-toed chemical-resistant boots OR steel-toed leather work boots with outer rubber boot covers, inner nitrile surgical gloves and outer chemical-resistant nitrile gloves	Hardhat <sup>b</sup> , splash-shield <sup>b</sup> , safety glasses, ear protection <sup>c</sup> , spectacle inserts	APR, full face, MSA Ultratwin or equivalent with GME-H cartridges or equivalent

<sup>a</sup> Modifications are as indicated above. Use of work clothes versus tyvek suits is based on potential for dermal exposure, as determined by the SSC

<sup>b</sup> Hardhat and splash-shield areas are to be determined by the SSC

<sup>c</sup> Ear protection should be worn while working around drill rigs or other noise-producing equipment or when conversations cannot be held at distances of 3 feet or less without shouting.

## 7.2 Reasons to Upgrade or Downgrade Level of Protection

Levels of protection may be upgraded for the following reasons:

- Request of individual performing task
- Occurrence or likely occurrence of gas or vapor emission
- Presence of visible dust during excavation activities
- Known or suspected presence of dermal hazards
- Instrument action levels (see Section 9) exceeded
- Change in work task that will increase contact or potential contact with hazardous materials

Levels of protection may be downgraded for the following reasons:

- New information indicating that situation is less hazardous than originally thought
- Change in site conditions that decreases the hazard
- Change in work task that will reduce contact with hazardous materials

## 8.0 Medical Surveillance

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### **(REFERENCE CH2M HILL SOP HS-01)**

Employees enrolled in the CH2M HILL Comprehensive Health and Safety Program who work at hazardous waste operations are subject to CH2M HILL's standard hazardous waste protocol. The hazardous waste protocol consists of initial, annual, biennial, and exit examinations. Each examination generally consists of a medical history, and tests specified by the corporate consulting occupational physician. For employees requiring annual examinations, biological monitoring tests based on the employee's exposure history and site activity are also performed.

For employees who have zero to 29 days of site time, medical examinations expire two years to the day after the previous examination. For employees who have 30 or more days of site time, medical examinations expire one year to the day after the previous examination. The initial examination identifies conditions that could place an employee at increased risk of health impairment as a result of the performance of his or her job, to identify work restrictions, and to establish a baseline for future comparisons. The annual and biennial examinations are designed to detect occupational exposures or illnesses that may have developed since the initial examination.

For employees requiring annual examinations, a summary of site activity and exposure history is used to determine what special biological monitoring tests are performed. A summary of the employee's site activity linked to a site contaminant database allows a history of possible exposure to be developed. This helps determine what specialized biological monitoring tests are performed for the annual medical examination.

## 9.0 Monitoring

### 9.1 Air Monitoring Specifications (REFERENCE CH2M HILL SOP HS-06)

#### EXHIBIT 9-1

#### Air Monitoring Specifications Health and Safety Plan

Instrument	Tasks	Action Levels		Frequency	Calibration
CGI: MSA model 260 or 261 or equivalent	Drilling and soil boring logging	0-10% 10-25% LEL: >25% LEL	No explosion hazard Potential explosion hazard Explosion hazard, evacuate or vent	Continuous during advancement of boring or trench	Daily
PID: HNu with 10.2 eV probe or equivalent, or FID, OVA-128	Drilling and soil boring logging	0-10 ppm	Level D or Modified Level D Modified Level D (provided other action levels are not met)	Initially (when opening monitoring well) and periodically throughout task.	Daily
	Groundwater sampling	> 10 ppm	Level C (provided other action levels are not met)		
	Soil sampling		Shutdown operations and allow vapors to vent to < 1 ppm before continuing		
	Monitoring well installation	> 25 ppm			
	Water level measurements				
Detector Tube: Drager benzene specific 0.5/c (0.5 to 10 ppm range) with pre-tube, or equivalent	When PID readings exceed 10 ppm	<0.5 ppm 0.5-1 ppm >10ppm	Level D Level C Shutdown operations and allow vapors to vent to < 1 ppm before continuing	Initially and periodically when PID/FIB >1 ppm	Not applicable
Dust Monitor: Miniram model PDM-3 or equivalent	Drilling and soil boring logging	<0.5 mg/m <sup>3</sup> >0.5 mg/m <sup>3</sup>	Level D Level C	Initially and periodically during tasks	Zero Daily

<sup>a</sup> Action levels apply to sustained breathing-zone measurements above background

<sup>b</sup> The exact frequency of monitoring depends on field conditions and is to be determined by the SSC, generally, every 5 to 15 minutes if acceptable, more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.)

<sup>c</sup> If the measured percent of O<sub>2</sub> is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O<sub>2</sub> action levels apply only to ambient working atmospheres, and not to confined-space entry. More stringent percent LEL and O<sub>2</sub> action levels are required for confined-space entry (refer to Section 2).

Where control measures are used (e.g., industrial fan), collect breathing zone measurements to ensure effectiveness of controls. Increased levels of protection may not be required when control measures effectively reduce breathing zone concentrations to levels below action levels.

## 9.2 Calibration Specifications

### EXHIBIT 9-2

#### Calibration Specifications Health and Safety Plan

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 eV lamp	100 ppm isobutylene	RF = 0.55	55 ppm	1.5 l/m reg T-tubing
FID: OVA-128	100 ppm methane	3.0 ± 1.5	100 ppm	1.5 l/m reg T-tubing
<b>Dust Monitor:</b> Miniram-PDM3	Dust-free air	Not applicable N/A	0.00 mg/m <sup>3</sup> in "Measure" mode	Dust-free area OR Z-bag with HEPA filter
<b>CGI:</b> MSA 260, 261, 360, or 361	0.75% pentane		50% LEL ± 5% LEL	1.5 lpm reg direct tubing

Note: Calibration procedures for OVM datalogger, OVA-128, and MSA Model 260, 261 are shown in Attachment 3. Calibration procedure for Miniram-PDM3 will come with equipment order

# 10.0 Site Control

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## 10.1 Work Practices

The SSC will establish areas for eating, drinking, and smoking and will inform personnel of the following work practices required during performance of field investigation activities at Richards-Gebaur AFB:

- No spark sources are permitted within exclusion or decontamination zones.
- Avoid visibly contaminated areas.
- No eating, drinking, or smoking is permitted in contaminated areas, or exclusion or decontamination zones.
- No contact lenses are permitted in exclusion or decontamination zones.
- No facial hair that would interfere with respirator fit is permitted if Level C or B is expected.
- Site work will be performed during daylight hours whenever possible. Any work conducted during hours of darkness will require enough illumination intensity to read a newspaper without difficulty.

## 10.2 Site Control Measures

The SSC must employ the following site control measures:

- Conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Record safety briefing attendance in logbook, and documents topics discussed.
- Post OSHA job site poster in a central and conspicuous location at the site where project field offices, trailers or storage boxes are established.
- Determine wind direction.
- Establish work zones (support, decontamination, and exclusion zones) and delineate work zones with flagging or cones as appropriate. Support zone is to be located upwind of site (see Exhibit 4-1).
- Establish decontamination procedures, including respirator decontamination procedures, and test.
- Utilize access control at the entry and exit from each work zone.
- Store chemicals in proper containers.
- Make MSDSs available for onsite chemicals to which employees are exposed.

- Establish onsite communications. These should consist of:
  - Line of sight/hand signals
  - Air horn
  - cellular phones
- Establish emergency signals. For example:
  - Grasping throat with hand – EMERGENCY - HELP ME
  - Grasping buddy wrist - LEAVE AREA NOW
  - Thumbs up - OK, UNDERSTOOD
  - Two short blasts on air horn - ALL CLEAR
  - Continuous air horn – EMERGENCY - EVACUATE
- Establish offsite communications.
- Establish buddy system.
- Establish procedures for disposal of material generated onsite.
- Conduct initial air monitoring by the SSC in appropriate level of protection.
- Conduct periodic inspections of work practices to determine effectiveness of this plan. Deficiencies are to be noted, reported to the District or Regional Health and Safety Manager, and corrected.
- Include a general discussion of the HSP, site specific hazards, locations of work zones, PPE requirements, equipment, special procedures, and emergencies when briefing personnel on site safety.

# 11.0 Decontamination Procedures

## (REFERENCE CH2M HILL SOP HS-13)

The decontamination procedures are presented in **Exhibit 11-1**.

### EXHIBIT 11-1

Decontamination Procedures  
*Health and Safety Plan*

Personnel	Sample Equipment	Heavy Equipment
Boot wash / rinse	Wash / rinse equipment	Power wash
Glove wash / rinse	Solvent rinse equipment	Steam clean
Outer glove removal	Solvent disposal method: drummed and disposed of in sanitary sewer, treated and discharged, or other suitable management designated by Air Force officials	Water disposal method: drummed and disposed of in sanitary sewer, treated and discharged, or other suitable management designated by Air Force officials
Body suit removal		
Inner glove removal		
Respirator removal		
Hand wash / rinse		
Face wash / rinse		
Shower (as soon as possible)		
PPE disposal method: drummed		
Water disposal method drummed and disposed of in sanitary sewer, treated and discharged, or other suitable management designated by Richards-Gebaur AFB officials		



## 12.0 Confined Space Entry

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Confined space entry is not anticipated under this contract. However, confined space entry requires an additional HSP and a permit. Refer to CH2M HILL SOP HS-17, *Confined Space Entry*, contained in the CH2M HILL *Corporate Health and Safety Program –Program and Training Manual*.

# 13.0 Emergency Response Plan

(REFERENCE CH2M HILL SOP HS-12)

## 13.1 Pre-Emergency Planning

The SSC performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with the facility and local emergency service providers as appropriate.

- Locate nearest telephone to the site and inspect onsite communications
- Locate chemical, safety, radiological, biological hazards
- Confirm and post emergency telephone numbers and route to hospital
- Post site map marked with location of emergency equipment and supplies
- Review emergency response plan for applicability to any changed site conditions, alterations in onsite operations, or personnel availability
- Evaluate capabilities of local response teams
- Where appropriate and acceptable to the client, inform emergency room/ambulance service and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities
- Inventory and check site emergency equipment and supplies
- Review emergency procedures for personnel injury, exposures, fires, explosions, chemical and vapor releases with field personnel
- Locate onsite emergency equipment and supplies of clean water
- Verify local emergency contacts, hospital routes, evacuation routes, and assembly points
- Review names of onsite personnel trained in first aid and CPR
- Review notification procedures for contacting CH2M HILL's medical consultant and team member's occupational physician
- Brief new workers on the emergency response plan

## 13.2 Emergency Equipment and Supplies

The SSC marks the locations of emergency equipment on the site map and posts the map in the support zone. All field sampling vehicles contain the following:

- ABC fire extinguisher
- Industrial first aid kit; including bloodborne pathogen kit
- Facility emergency equipment
- Potable water

- Eye wash
- Cellular phone

### 13.3 Emergency Medical Treatment

The SSC will assume charge during a medical emergency until the ambulance arrives, or the injured person is admitted to the emergency room. As part of these responsibilities, the SSC should:

- Prevent further injury
- Initiate first aid and CPR
- Call the ambulance and hospital
- Determine if decontamination will make injury worse. If it will, seek medical treatment immediately
- Make certain that injured person is accompanied to emergency room
- Notify the Project Manager of the injury
- Notify the District or Regional Health and Safety Manager
- Notify the injured person's human resources department
- Prepare an incident report Submit this to the Corporate Director Health and Safety (SEA) and Corporate Human Resources Department (DEN) within 48 hours.

### 13.4 Emergency Medical Treatment

The procedures listed above may be applied to nonemergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant.

- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name, your telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Follow these procedures as appropriate.

### 13.5 Evacuation

- 1 Evacuation routes will be designated by SSC before beginning work.
2. Onsite and offsite assembly points will be designated before beginning work.

3. Personnel will exit the exclusion zone and assemble at the onsite assembly point upon hearing the emergency signal for evacuation of the exclusion zone.
4. Personnel will assemble at the offsite point upon hearing the emergency signal for a site evacuation.
5. The SSC and a "buddy" will remain onsite after the site has been evacuated (if possible) to assist local responders and advise them of the nature and location of the incident.
6. SSC accounts for all personnel in the onsite assembly zone
7. A person designated by the SSC (prior to work) will account for personnel at the offsite assembly area.
8. The SSC is to write up the incident as soon as possible after it occurs, and submit a report to the Corporate Director Health and Safety.

## 13.6 Evacuation Routes and Assembly Points

In general, personnel will use an upwind or crosswind route in event of an evacuation. For sites located on the main areas of the base, the assembly point will be at the Richards-Gebaur AFB Field Office. Assembly points for remote sites and the evacuation route will be discussed during the initial health and safety briefing.

## 13.7 Evacuation Signals

**Exclusion Zone/Site.** The buddy system.

- Grab buddy's wrist; Leave area now
- Verbal communication

## 13.8 Emergency Response Telephone Numbers

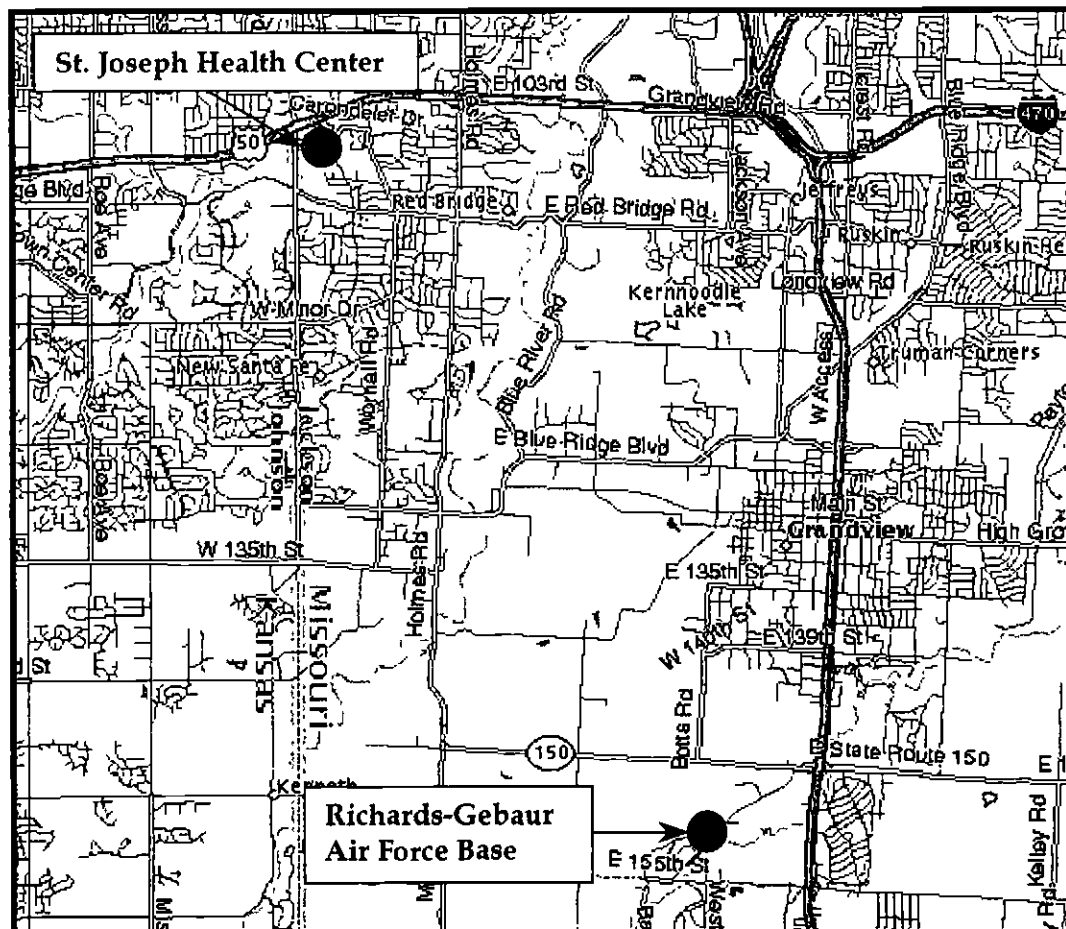
Exhibit 13-1 presents the routes from the sites to the closest hospital. Exhibit 13-2 presents telephone numbers that should be called in the event of an emergency.

## Exhibit 13-1

## Base Emergency Hospital Routes for Richards-Gebaur AFB

Starting From: 1	Arriving At: 2	Distance	Approximate Travel Time
Richards-Gebaur Air Force Base	St. Joseph Health Center	10.9 miles	18 mins
15411 Andrews Road Kansas City, MO 64147	1000 Carondelet Dr Kansas City, MO 64114		

Directions	miles
1. Start out going Northeast on ANDREWS RD towards E 147TH ST.	0.6
2. Turn RIGHT onto E 147TH ST.	0.2
3. Stay straight to go onto E SR-150.	0.1
4. Turn LEFT to take the US-71 NORTH ramp towards KANSAS CITY.	0.2
5. Merge onto US-71 N.	4.8
6. Take the I-435 WEST/US-50/I-470 EAST exit towards LEE'S SUMMIT/WICHITA.	0.1
7. Take the I-435 WEST/US-50 WEST exit on left towards WICHITA.	1.0
8. Merge onto US-50 W.	3.3
9. Take the STATE LINE ROAD exit	0.2
10. Turn LEFT onto STATE LINE RD.	0.2
11. Turn LEFT onto CARONDELET DR.	



**EXHIBIT 13-2**  
**Emergency Response Telephone Numbers**  
*Health and Safety Plan*

<b>Site</b>	<b>Telephone Number</b>
Police	(816) 331-5522 or 911
Fire	(816) 763-3900 or 911
Richards-Gebaur AFB Point of Contact	Dave Malecki (614) 492-8065
St. Joseph Health Center	(816) 942-4400

## **13.9 Government Agencies Involved In Project**

**Federal: AFCEE      Telephone Number: (210) 536-6451**

Ms. Kay Grosinske  
 HQ AFCEE/ERB  
 3207 North Road  
 Brooks AFB  
 San Antonio, Texas 78235-5363

## **13.10 Emergency Contacts**

**CH2M HILL Medical Consultant**  
 Dr. Elayne F. Theriault, Medical Director  
 Environmental Medicine Resources, Inc.  
 Atlanta, Georgia  
 800-229-3674 or 404-455-0818  
 (after hours calls will be returned within 20 minutes)

**Occupational Physicians**  
 Barnes Care  
 401 Pine Street  
 St. Louis, MO  
 (314) 331-4021

**Corporate Director Health and Safety**  
 Name: David Waite/Seattle, WA  
 Phone: 206-453-5005

**Site Safety Coordinator**  
 Name: Chris English/St. Louis, MO  
 Phone: (314) 421-0313 ext. 221

**Health and Safety Manager**

Name: Richard Rathnow/ Milwaukee, WI  
Phone: (414) 272-2426

**Regional Manager**

Name: Pat Taylor-Woodyard/Milwaukee, WI  
Phone: (414) 272-2426

**Project Manager**

Name: Peter Barrett/St. Louis, MO  
Phone: (314) 421-0313 ext. 241

**Radiation Health Manager (RHM)**

Name: Frank Petelka/Oak Ridge, TN  
Phone: (615) 483-9032 (office)  
(615) 482-8667 (home)

**Regional Human Resources**

Name: Denise O'Brien-Snell/Milwaukee, WI  
Phone: (414) 272-2426

**Richards-Gebaur AFB Contact**

Name: Mike Nicklow  
Phone: (517) 739-4988

**Corporate Human Resources Department**

Name: Julie Zimmerman/Denver, CO  
Phone: (303)-771-0900

If an injury occurs, notify the injured person's personnel office as soon as possible after obtaining medical attention for the injured. Notification MUST be made within 24 hours of the injury.

## 14.0 Plan Approval

---

This HSP has been written for use by CH2M HILL. CH2M HILL claims no responsibility for its use by others, unless specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions change.

**PLAN WRITTEN BY:** Chris English/St. Louis, MO      **DATE:** July 1999

**PLAN APPROVED BY:** Angelo Liberatore/Atlanta, GA      **DATE:** July 1999

### Plan Amendments

None



**Attachment 1**  
**Employee Sign-Off**

[illegible]

Attachment 2  
**Applicable MSDSs**

186 475

SCOTT SPECIALTY GASES -- ISOBUTYLENE IN AIR - CALIBRATION GAS CYL  
MATERIAL SAFETY DATA SHEET  
NSN: 6665012148247  
Manufacturer's CAGE: 51847  
Part No. Indicator: A  
Part Number/Trade Name: ISOBUTYLENE IN AIR

## General Information

Item Name: CALIBRATION GAS CYL  
Company's Name: SCOTT SPECIALTY GASES  
Company's Street: ROUTE 611 NORTH  
Company's City: PLUMSTEADVILLE  
Company's State: PA  
Company's Country: US  
Company's Zip Code: 18949  
Company's Emerg Ph #: 215-766-8861; 908-754-7700  
Company's Info Ph #: 215-766-8861  
Record No. For Safety Entry: 003  
Tot Safety Entries This Stk#: 005  
Status: SMJ  
Date MSDS Prepared: 23APR92  
Safety Data Review Date: 27SEP94  
MSDS Serial Number: BVRGC  
Hazard Characteristic Code: G3

## Ingredients/Identity Information

Proprietary: NO  
Ingredient: PROPENE, 2-METHYL-; (ISOBUTYLENE)  
Ingredient Sequence Number: 01  
NIOSH (RTECS) Number: UD0890000  
CAS Number: 115-11-7  
OSHA PEL: N/K (FP N)  
ACGIH TLV: N/K (FP N)

Proprietary: NO  
Ingredient: AIR, REFRIGERATED LIQUID; AIR COMPRESSED (UN1002, DOT); AIR  
REFRIGERATED LIQUID (CRYOGENIC LIQUID) (UN1003) (DOT)  
Ingredient Sequence Number: 02  
NIOSH (RTECS) Number: AX5271000  
OSHA PEL: N/K (FP N)  
ACGIH TLV: N/K (FP N)

## Physical/Chemical Characteristics

Appearance And Odor: COLORLESS GAS W/POSSIBLE SLIGHT OLEFINIC ODOR.  
Boiling Point: -318F, -194C  
Vapor Pressure (MM Hg/70 F): N/A  
Vapor Density (Air=1): 1.2  
Specific Gravity: 0.88 (H\*20=1)  
Evaporation Rate And Ref: NOT APPLICABLE  
Solubility In Water: INSOLUBLE  
Percent Volatiles By Volume: 100

## Fire and Explosion Hazard Data

Flash Point: NONFLAMMABLE  
Lower Explosive Limit: N/A  
Upper Explosive Limit: N/A  
Extinguishing Media: USE WHAT IS APPROPRIATE FOR SURROUNDING FIRE.  
Special Fire Fighting Proc: USE NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE  
EQUIPMENT (FP N). USE WATER SPRAY TO KEEP FIRE EXPOSED CYLINDERS COOL.

186 476

Unusual Fire And Expl Hazrds: COMPRESSED AIR AT HIGH PRESSURES WILL ACCELERATE THE BURNING OF FLAMMABLE MATERIALS.

Reactivity Data

Stability: YES  
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.  
Materials To Avoid: NONE.  
Hazardous Decomp Products: NONE.  
Hazardous Poly Occur: NO  
Conditions To Avoid (Poly): NOT RELEVANT

Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.  
Route Of Entry - Inhalation: YES  
Route Of Entry - Skin: NO  
Route Of Entry - Ingestion: NO  
Health Haz Acute And Chronic: ACUTE:CONCENTRATION OF ISOBUTYLENE IS THIS MIXTURE SHOULD NOT PRESENT ANY SYMPTOMS OF TOXICITY. CHRONIC:NONE.  
Carcinogenicity - NTP: NO  
Carcinogenicity - IARC: NO  
Carcinogenicity - OSHA: NO  
Explanation Carcinogenicity: NOT RELEVANT  
Signs/Symptoms Of Overexp: NONE SPECIFIED BY MANUFACTURER.  
Med Cond Aggravated By Exp: NONE.  
IMMEDIATELY FLUSH W/POTABLE WATER FOR A MINIMUM OF 15 MINUTES, SEEK ASSISTANCE FROM MD (FP N). SKIN:FLUSH W/COPIOUS AMOUNTS OF WATER. CALL MD (FP N). INHAL:IMMEDIATELY REMOVE VICTIM TO FRESH AIR. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: EVACUATE & VENTILATE AREA. REMOVE LEAKING CYLINDER TO EXHAUST HOOD OR SAFE OUTDOORS AREA IF THIS CAN BE DONE SAFELY.  
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.  
Waste Disposal Method: DISPOSAL MUST BE I/A/W FEDERAL, STATE & LOCAL REGULATIONS (FP N). RETURN CYLS TO SUPPLIER FOR PROPER DISP W/ANY VALVE OUTLET PLUGS/CAPS SECURED & VALVE PROT CAP IN PLACE. ALLOW GAS TO DISCHARGE AT SLOW RATE TO ATM IN UNCONFINED AREA/EXHST HOOD.  
Precautions-Handling/Storing: STORE IN WELL VENTILATED AREAS ONLY. KEEP VALVE PROT CAP ON CYLS WHEN NOT IN USE & SECURE CYL WHEN USING TO PROT FROM FALLING.  
Other Precautions: USE SUITABLE HAND TRUCK TO MOVE CYLS. PROT CYLS FROM PHYSICAL DMG. DO NOT DEFACE CYLS/LBLS. MOVE CYL W/ADEQ HAND TRUCK. CYL SHOULD BE REFILLED BY QUALIFIED PRODUCERS OF COMPRESSED GAS. SHIPMENT OF COMPRESSED GAS CYL WHICH HAS NOT (SUPDAT)

Control Measures

Respiratory Protection: USE NIOSH/MSHA APPROVED SCBA IN CASE OF EMERGENCY OR NON-ROUTINE USE.  
Ventilation: PROVIDE ADEQUATE GENERAL & LOCAL EXHAUST VENTILATION.  
Protective Gloves: RUBBER GLOVES.  
Eye Protection: ANSI APPROVED CHEM WORKERS GOGGS (FP N).  
Other Protective Equipment: WEAR SAFETY SHOES. A SAFETY SHOWER & EYEWASH STATION SHOULD BE READILY AVAILABLE.  
Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.  
Suppl. Safety & Health Data: OTHER PREC:BEEN FILLED BY OWNER OR WITH HIS WRITTEN CONSENT IS A VIOLATION OF FEDERAL LAW (49 CFR).

Transportation Data

186 477

Trans Data Review Date: 94269

## =====

## Disposal Data

## =====

## Label Data

=====

Label Required: YES

Technical Review Date: 27SEP94

Label Date: 26SEP94

Label Status: G

Common Name: ISOBUTYLENE IN AIR

Chronic Hazard: NO

Signal Word: NONE

Acute Health Hazard-None: X

Contact Hazard-None: X

Fire Hazard-None: X

Reactivity Hazard-None: X

Special Hazard Precautions: ACUTE:CONCENTRATION OF ISOBUTYLENE IS THIS  
MIXTURE SHOULD NOT PRESENT ANY SYMPTOMS OF TOXICITY. CHRONIC:NONE LISTED BY  
MANUFACTURER.

Protect Eye: Y

Protect Skin: Y

Protect Respiratory: Y

Label Name: SCOTT SPECIALTY GASES

Label Street: ROUTE 611 NORTH

Label City: PLUMSTEADVILLE

Label State: PA

Label Zip Code: 18949

Label Country: US

Label Emergency Number: 215-766-8861; 908-754-7700

186 478

BACHARACH -- 51-2394 CALIBRATION GAS, METHANE 2% IN AIR

MATERIAL SAFETY DATA SHEET

NSN: 683000F042761

Manufacturer's CAGE: 05083

Part No. Indicator: A

Part Number/Trade Name: 51-2394 CALIBRATION GAS, METHANE 2% IN AIR

=====  
General Information=====  
Company's Name: BACHARACH INC  
Company's Street: 625 ALPHA DR  
Company's City: PITTSBURGH  
Company's State: PA  
Company's Country: US  
Company's Zip Code: 15238  
Company's Emerg Ph #: 800-424-9300  
Company's Info Ph #: 412-963-2223 OR FAX 412-963-2091  
Record No. For Safety Entry: 001  
Tot Safety Entries This Stk#: 001  
Status: SE  
Date MSDS Prepared: 20MAR92  
Safety Data Review Date: 18FEB94  
Preparer's Company: BACHARACH INC  
Preparer's St Or P. O. Box: 625 ALPHA DR  
Preparer's City: PITTSBURGH  
Preparer's State: PA  
Preparer's Zip Code: 15238  
MSDS Serial Number: BXXPQ  
==========  
Ingredients/Identity Information=====  
Proprietary: NO  
Ingredient: METHANE  
Ingredient Sequence Number: 01  
Percent: 2.0  
NIOSH (RTECS) Number: PA1490000  
CAS Number: 74-82-8  
ACGIH TLV: SIMPLE ASPHYXIAN  
-----Proprietary: NO  
Ingredient: AIR  
Ingredient Sequence Number: 02  
Percent: 98  
NIOSH (RTECS) Number: 1005486AI  
=====

## Physical/Chemical Characteristics

=====  
Appearance And Odor: COLORLESS, ODORLESS, TASTELESS COMPRESSED GAS IN CYLINDERS.  
Boiling Point: -162C  
Melting Point: -182C  
Vapor Density (Air=1): 0.991  
Specific Gravity: 0.673 KG/CUM  
Solubility In Water: NEGLIGIBLE  
=====

## Fire and Explosion Hazard Data

=====  
Flash Point: -188C  
Flash Point Method: CC  
Lower Explosive Limit: 5%  
Upper Explosive Limit: 15%  
Extinguishing Media: COOL EXPOSED CONTAINERS W/WATER.  
Special Fire Fighting Proc: FIREFIGHTERS SHOULD WEAR NIOSH APPROVED  
=====

186 479

POSITIVE PRESSURE SCBA & FULL PROTECTIVE CLOTHING. USE SHIELDING TO PROTECT FROM CYLINDER EXPLOSION

Unusual Fire And Expl Hazrds: THIS MIXTURE IS BELOW THE LEL OF METHANE & NON-FLAMMABLE. COMPRESSED AIR/METHANE MIXTURES AT HIGH PRESSURE WILL ACCELERATE BURNING OF OTHER MATERIAL. (SUPP)

Reactivity Data

Stability: YES

Cond To Avoid (Stability): HEAT, FLAMES

Hazardous Poly Occur: NO

Health Hazard Data

Route Of Entry - Inhalation: NO

Route Of Entry - Skin: NO

Route Of Entry - Ingestion: NO

Health Haz Acute And Chronic: METHANE IS A NON-TOXIC SIMPLE ASPHYXIAN. THE CONCENTRATION OF METHANE IN THIS GAS IS TOO LOW TO DEPRESS OXYGEN CONCENTRATION.

Carcinogenicity - NTP: NO

Carcinogenicity - IARC: NO

Carcinogenicity - OSHA: NO

Explanation Carcinogenicity: NONE

Emergency/First Aid Proc: OBTAIN MEDICAL ATTENTION IN ALL CASES.

Precautions for Safe Handling and Use

Waste Disposal Method: DISPOSE OF IN ACCORDANCE W/LOCAL, STATE, & FEDERAL REGULATIONS.

Precautions-Handling/Storing: DON'T STORE CYLINDERS NEAR HEAT/OPEN FLAME. EXPOSURE TO TEMPERATURES ABOVE 130F MAY CAUSE RUPTURE, SECURE CYLINDERS- DON'T DROP.

Other Precautions: KEEP CYLINDERS AWAY FROM HEAT & FLAMES.

Control Measures

Respiratory Protection: RECOMMENDED

Protective Gloves: LEATHER

Eye Protection: SAFETY GLASSES

Suppl. Safety & Health Data: CON'T ON UNUSUAL FIRE: GAS CYLINDERS EXPOSED TO HEAT/FLAME MAY VENT RAPIDLY/EXPLODE. THE DATA FOR BOILING POINT, MELTING POINT AND FLASH POINT IS FOR METHANE. AUTOIGNITION TEMPERATURE: 580C METHANE.

Transportation Data

Disposal Data

Label Data

Label Required: YES

Technical Review Date: 18FEB94

Label Date: 16FEB94

Label Status: F

Common Name: CALIBRATION GAS 2% METHANE

Chronic Hazard: NO

Signal Word: NONE

Acute Health Hazard-None: X

Contact Hazard-None: X

Fire Hazard-None: X

Reactivity Hazard-None: X



186 480

Special Hazard Precautions: METHANE IS A NON-TOXIC SIMPLE ASPHYXIAANT. THE CONCENTRATION OF METHANE IN THIS GAS IS TOO LOW TO DEPRESS OXYGEN CONCENTRATION.

Protect Skin: Y

Label Name: BACHARACH INC

Label Street: 625 ALPHA DR

Label City: PITTSBURGH

Label State: PA

Label Zip Code: 15238

Label Country: US

Label Emergency Number: 800-424-9300

Year Procured: UNK

BARTLETT CHEMICALS -- HYDROCHLORIC ACID 20 BE, NPU 588227 - HYDROCHLORIC ACID, TECHN  
MATERIAL SAFETY DATA SHEET  
NSN: 6810002365665  
Manufacturer's CAGE: 1V771  
Part No. Indicator: A  
Part Number/Trade Name: HYDROCHLORIC ACID 20 BE, NPU 588227

=====  
General Information  
=====

Item Name: HYDROCHLORIC ACID, TECHNICAL  
Company's Name: BARTLETT CHEMICALS  
Company's Street: 4955 RIVER ROAD  
Company's P. O. Box: 10710  
Company's City: JEFFERSON  
Company's State: LA  
Company's Country: US  
Company's Zip Code: 70121  
Company's Emerg Ph #: 800-832-HELP/800-424-9300 (CHEMTREC)  
Company's Info Ph #: 504-734-1971  
Record No. For Safety Entry: 005  
Tot Safety Entries This Stk#: 018  
Status: SE  
Date MSDS Prepared: 30NOV93  
Safety Data Review Date: 07DEC94  
Supply Item Manager: CX  
MSDS Serial Number: BVWWR  
Specification Number: ASTM E-1146-92  
Hazard Characteristic Code: C1  
Unit Of Issue: DR  
Unit Of Issue Container Qty: 5 GALLON  
Type Of Container: POLYETHYLENE

=====  
Ingredients/Identity Information  
=====

Proprietary: NO  
Ingredient: HYDROCHLORIC ACID  
Ingredient Sequence Number: 01  
Percent: 31-35  
NIOSH (RTECS) Number: MW4025000  
CAS Number: 7647-01-0  
OSHA PEL: NOT ESTABLISHED  
ACGIH TLV: NOT ESTABLISHED  
Other Recommended Limit: NONE RECOMMENDED

-----  
Proprietary: NO  
Ingredient: WATER  
Ingredient Sequence Number: 02  
Percent: 65-69  
NIOSH (RTECS) Number: ZC0110000  
CAS Number: 7732-18-5  
OSHA PEL: NOT ESTABLISHED  
ACGIH TLV: NOT ESTABLISHED  
Other Recommended Limit: NONE RECOMMENDED

=====  
Physical/Chemical Characteristics  
=====

Appearance And Odor: WATER WHITE TO STRAW YELLOW COLOR, LIQUID, PUNGENT,  
STRONG ODOR.  
Boiling Point: 183F, 84C  
Melting Point: -51F, -46C  
Vapor Pressure (MM Hg/70 F): 16-17 @20C  
Decomposition Temperature: 3240F, 1782C  
Solubility In Water: COMPLETELY SOLUBLE

pH: 1

Autoignition Temperature: N/A

=====

Fire and Explosion Hazard Data

=====

Flash Point: NOT AVAILABLE

Lower Explosive Limit: N/A

Upper Explosive Limit: N/A

Extinguishing Media: NON-FLAMMABLE. THE PRESENCE OF HCL WILL NOT LIMIT THE CHOICE OF EXTINGUISHING MEDIA.

Special Fire Fighting Proc: FIREFIGHTERS SHOULD BE EQUIPPED W/SELF-CONTAINED BREATHING APPARATUS &amp; TURN-OUT GEAR. WATER FOG WILL BE MOST EFFECTIVE FOR CONTROLLING HCL VAPORS.

Unusual Fire And Expl Hazrds: NONE KNOWN. ADDITIONALLY, HCL DOES NOT DECOMPOSE @ TEMP &lt;1500C. IT'S NON-FLAMM; HOWEVER FLAMM &amp; POTENTIALLY EXPLOSIVE HYDROGEN GAS IS GENERATED FROM RX W/MOST METAL

=====

Reactivity Data

=====

Stability: YES

Cond To Avoid (Stability): PREVENT IGN OF HYDROGEN GAS FROM MURIATIC ACID AVOID MOST METAL CONTACTS; SMOKING, FLAMES, SPARKS NOT IN STORAGE/HANDLE AREA Materials To Avoid: MOST METALS, ALKALIES, METALLIC OXIDES, AMINES, ESTERS, CERTAIN OTHER ORG. CARBONATES, CYANIDES, SULFIDES. WATER REACTIVE MATLS.

Hazardous Decomp Products: DOES NOT DECOMPOSE.

Hazardous Poly Occur: NO

Conditions To Avoid (Poly): NOT APPLICABLE

=====

Health Hazard Data

=====

LD50-LC50 Mixture: UNKNOWN

Route Of Entry - Inhalation: YES

Route Of Entry - Skin: YES

Route Of Entry - Ingestion: YES

Health Haz Acute And Chronic: ACUTE. CORR TO BODY TISSUES. BURNS, PERM EYE INJURY. DERM/DEEP BURNS FROM SKIN CONTACT. INHAL: COUGHING/CHOKING SENSATION FROM UPPER RESP TRACT IRRIT. LARYNGEAL SPASM &amp; EDEMA &amp; PULM EDEMA FROM SEVERE OVEREXPO. INGEST: NAU, VOMIT, DAMAGE TO GI TRACT W/ULCERATION &amp; HEMORRHAGE. CHRONIC: PULM FUNCTION CHANGES, CHRONIC BRON, (SUPPLEMENT)

Carcinogenicity - NTP: NO

Carcinogenicity - IARC: NO

Carcinogenicity - OSHA: NO

Signs/Symptoms Of Overexp: CORROSIVE TO BODY TISSUES. BURNS &amp; PERM EYE INJURY. COUGHING, CHOKING SENSATION FROM UPPER RESP IRRIT. LARYNGEAL SPASM, LARYNGEAL EDEMA, PULMONARY EDEMA. NAUSEA, VOMITING, DAMAGE TO GI TRACT W/ULCERATION &amp; HEMORRHAGE. PULMONARY FUNCTION CHANGES, BRONCHITIS, DERM, EROSION OF TOOTH ENAMEL, CONJUNCTIVITIS.

Med Cond Aggravated By Exp: INDIVIDUALS W/PRE-EXISTING DISEASES OF SKIN, ASTHMA, OR OTHER RESP DISORDERS MAY HAVE INCREASED SUSCEPTIBILITY TO EXCESSIVE EXPOSURES.

Emergency/First Aid Proc: SKIN: WASH W/ SOAP &amp; WATER. REMOVE CONTAMIN CLOTH. EYES: IMMEDIATELY RINSE W/RUNNING WATER FOR 15 MINS. INGEST: DILUTE W/WATER. DO NOT INDUCE VOMIT. NEVER GIVE FLUIDS OR INDUCE VOMIT IF UNCONSC OR HAVING CONVULSIONS. INHAL: MOVE TO FRESH AIR. AID IN BREATHING. IN ALL CASES GET IMMEDIATE MED ATTN.

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: SPILLS SHOULD BE CONTAINED, DILUTED CAUTIOUSLY W/WATER &amp; NEUTRALIZED W/SODA ASH OR LIME.

Neutralizing Agent: SODA ASH OR LIME.

Waste Disposal Method: NEUTRALIZED WASTE MUST BE DISPOSED OF IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS. UNUSED MATERIAL &amp; EMPTY CONTAINERS MUST BE DISPOSED OF IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL

## REGULATIONS.

Precautions-Handling/Storing: DUE TO ITS HAZ NATURE, STORAGE FACILITIES MUST BE PROPERLY DESIGNED & DIKED TO CONTAIN ANY SPILLAGE. DRUM STORAGE SHOULD BE MAINTAINED BELOW 120F.

Other Precautions: NONE SPECIFIED BY MFG.

## Control Measures

Respiratory Protection: IF THE EXPOSURE LEVEL (PEL) IS EXCEEDED WEAR NIOSH APPROVED RESP FOR ACID GASES.

NONE REQUIRED. MAINTAIN WORK AREA BELOW PEL.

Protective Gloves: RUBBER GLOVES.

Eye Protection: FITTED CHEM GOGG OR FACESHIELD W/SAF GLS

Other Protective Equipment: COVERALLS, HARD HAT, BOOTS, RUBBER APRON TO AVOID SKIN CONTACT. EASILY ACCESSIBLE EYEWASH FOUNTAINS, SAFETY SHOWERS.

Work Hygienic Practices: LAUNDER CONTAMIN CLOTH BEFORE REUSE. CLEAN CONTAMIN EQPMT AFT USE OR DISPOSE OF.

Suppl. Safety & Health Data: HEALTH EFFECTS: DERM, EROSION OF TOOTH ENAMEL, CONJUNCTIVITIS, UPPER RESP TRACT IRRIT.

## Transportation Data

Trans Data Review Date: 94341

DOT PSN Code: HJG

DOT Proper Shipping Name: HYDROCHLORIC ACID, SOLUTION

DOT Class: 8

DOT ID Number: UN1789

DOT Pack Group: II

DOT Label: CORROSIVE

IMO PSN Code: IEX

IMO Proper Shipping Name: HYDROCHLORIC ACID

IMO Regulations Page Number: 8183

IMO UN Number: 1789

IMO UN Class: 8

IMO Subsidiary Risk Label: -

IATA PSN Code: NPG

IATA UN ID Number: 1789

IATA Proper Shipping Name: HYDROCHLORIC ACID

IATA UN Class: 8

IATA Label: CORROSIVE

AFI PSN Code: NPG

AFI Symbols: T

AFI Prop. Shipping Name: HYDROCHLORIC ACID, SOLUTION

AFI Class: 8

AFI ID Number: UN1789

AFI Pack Group: II

AFI Special Prov: A3, A6, N41

AFI Basic Pac Ref: 12-5

Additional Trans Data: PER CTDF: DOT: CLASS 8, SHIPPING NAME: HYDROCHLORIC ACID, SOLUTION UN1789.

## Disposal Data

## Label Data

Label Required: YES

Technical Review Date: 07DEC94

Label Status: F

Common Name: HYDROCHLORIC ACID 20 BE, NPU 588227

Signal Word: DANGER!

Acute Health Hazard-Moderate: X

Contact Hazard-Severe: X

Fire Hazard-None: X

186 484

Reactivity Hazard-None: X

Special Hazard Precautions: ACUTE:CORR TO BODY TISSUES.BURNS,PERM EYE  
INJURY.DERM/DEEP BURNS FROM SKIN CONTACT.INHAL:COUGH/CHOKE SENSATION FROM  
UPPER RESP TRACT IRRIT.LAR SPASM & EDEMA & PULM EDEMA FROM SEVE OVEREXPO.  
INGEST:NAU,VOMIT,DAMAGE TO GI TRACT W/ULCERATION & HEMORR.CHRONIC:PULM  
BODY TISSUE/EYE/SKIN/RESP & GI TRACTS.1ST AID:SKIN:WASH W/SOAP & WATER.  
DILUTE W/WATER.DO NOT INDUCE VOMIT.NEVER GIVE FLUIDS OR INDUCE VOMIT IF  
UNCONSC OR HAVING CONVULSIONS.INHAL:MOVE TO FRESH AIR.AID IN BREATH.IN ALL  
CASES GET IMMED MED ATTN.

Protect Eye: Y

Protect Skin: Y

Protect Respiratory: Y

Label Name: BARTLETT CHEMICALS

Label Street: 4955 RIVER ROAD

Label P.O. Box: 10710

Label City: JEFFERSON

Label State: LA

Label Zip Code: 70121

Label Country: US

Label Emergency Number: 800-832-HELP/800-424-9300(CHEMTREC)

PROCURED BY: DEFENSE GENERAL SUPPLY CENTER -- NITRIC ACID,TECHNICAL - NITRIC ACID,T  
 MATERIAL SAFETY DATA SHEET  
 NSN: 6810002229655  
 Manufacturer's CAGE: 13873  
 Part No. Indicator: A  
 Part Number/Trade Name: NITRIC ACID,TECHNICAL

=====  
 General Information  
 =====

Item Name: NITRIC ACID,TECHNICAL  
 Company's Name: PROCURED BY: DEFENSE GENERAL SUPPLY CENTER  
 Company's Street: 8000 JEFFERSON DAVIS HIGHWAY  
 Company's City: RICHMOND  
 Company's State: VA  
 Company's Country: US  
 Company's Zip Code: 23297-5680  
 Company's Emerg Ph #: 804-279-4371  
 Company's Info Ph #: 804-279-4371  
 Record No. For Safety Entry: 007  
 Tot Safety Entries This Stk#: 014  
 Status: SD  
 Date MSDS Prepared: 16JUN94  
 Safety Data Review Date: 09APR96  
 Supply Item Manager: CX  
 MSDS Preparer's Name: DGSC-SHH/HMIS(LEVIEN)  
 Preparer's Company: DEFENSE GENRAL SUPPLY CENTER  
 Preparer's St Or P. O. Box: 8000 JEFF-DAVIS HWY.  
 Preparer's City: RICHMOND  
 Preparer's State: VA  
 Preparer's Zip Code: 23297-5680  
 MSDS Serial Number: BTKPS  
 Specification Number: O-N-350  
 Spec Type, Grade, Class: NONE  
 Hazard Characteristic Code: C1  
 Unit Of Issue: BT  
 Unit Of Issue Container Qty: 500 ML  
 Type Of Container: BOTTLE  
 Net Unit Weight: 1.5 LBS

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 Ingredients/Identity Information  
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Proprietary: NO  
 Ingredient: NITRIC ACID (SARA III)  
 Ingredient Sequence Number: 01  
 Percent: 69-71  
 NIOSH (RTECS) Number: QU5775000  
 CAS Number: 7697-37-2  
 OSHA PEL: 2 PPM/4 STEL  
 ACGIH TLV: 2 PPM/4 STEL; 9192

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 Proprietary: NO  
 Ingredient: WATER  
 Ingredient Sequence Number: 02  
 Percent: BALANCE  
 NIOSH (RTECS) Number: ZC0110000  
 CAS Number: 7732-18-5  
 OSHA PEL: NOT ESTABLISHED  
 ACGIH TLV: NOT ESTABLISHED  
 Other Recommended Limit: NONE RECOMMENDED

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 Physical/Chemical Characteristics  
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Appearance And Odor: LIQUID;WHITE TO YELLOW(DARKENS WITH AGE AND LIGHT);

186 486

CHARACTERISTIC NO2 ODOR  
 Boiling Point: 186F, 86C  
 Melting Point: -30F, -34C  
 Vapor Pressure (MM Hg/70 F): 45  
 Specific Gravity: 1.38-1.5  
 Decomposition Temperature: UNKNOWN  
 Solubility In Water: COMPLETE  
 Percent Volatiles By Volume: 100  
 Corrosion Rate (IPY): CORROSIV

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Fire and Explosion Hazard Data

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Flash Point: NONE  
 Extinguishing Media: WATER SPRAY  
 Special Fire Fighting Proc: USE A SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE EQUIPMENT. COOL FIRE EXPOSED CONTAINERS WITH WATER FOG.  
 Unusual Fire And Expl Hazrds: NITRIC ACID IS NON-FLAMMABLE, BUT IT CAN REACT WITH COMBUSTIBLES TO CAUSE FIRES. IT CAN REACT WITH METALS TO LIBERATE HYDROGEN.

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Reactivity Data

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Stability: YES  
 Cond To Avoid (Stability): ORGANIC MATERIALS (WOOD, PAPER, ALCOHOL, TURPENTINE, H2S). MATERIALS HAVE INCREASED COMBUSTIBILITY AFTER CONTACT W/ HNO3.  
 Materials To Avoid: WHEN CONCENTRATED, NITRIC ACID ABSORBS WATER.  
 Hazardous Decomp Products: NITRIC ACID, OXIDES OF NITROGEN.  
 Hazardous Poly Occur: NO

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Health Hazard Data

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LD50-LC50 Mixture: LDLO HUMAN IS 430MG/KG  
 Route Of Entry - Inhalation: YES  
 Route Of Entry - Skin: YES  
 Route Of Entry - Ingestion: YES  
 Health Haz Acute And Chronic: NITRIC ACID IS CORROSIVE TO ALL TISSUE. INHAL: MAY LUNG IRRITATION OR DAMAGE. EYES: MAY CAUSE BURNS OR PERMANENT DAMAGE. SKIN: MAY CAUSE BURNS. INGEST: WILL BURN THE DIGESTIVE TRACT.  
 Carcinogenicity - NTP: NO  
 Carcinogenicity - IARC: NO  
 Carcinogenicity - OSHA: NO  
 Explanation Carcinogenicity: THERE ARE NO INGREDIENTS ABOVE 0.1% WHICH ARE IDENTIFIED AS CARCINOGENS BY NTP, IARC OR OSHA.  
 Signs/Symptoms Of Overexp: SKIN: MAY CAUSE SKIN TO TURN YELLOW.  
 Med Cond Aggravated By Exp: PERSONS WITH PRE-EXISTING RESPIRATORY AILMENTS MAY BE AT INCREASED RISK FROM EXPOSURE.  
 Emergency/First Aid Proc: SKIN: REMOVE CONTAMINATED CLOTHING; WASH WITH SOAP AND WATER. EYES: FLUSH WITH WATER FOR 15 MINUTES. INHAL: REMOVE TO FRESH AIR. GIVE OXYGEN OR ARTIFICIAL RESPIRATION IF NEEDED. INGEST: DO NOT INDUCE VOMITING. GET PROMPT QUALIFIED MEDICAL ATTENTION. IF CONSCIOUS, GIVE 3 OR MORE GLASSES OF WATER.

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: EVACUATE AREA; VENTILATE; USE PROPER RESPIRATORY AND PROTECTIVE EQUIPMENT. COVER WITH SODIUM BICARBONATE OR SODA ASH; WASH THE SLURRY DOWN THE DRAIN WITH EXCESS WATER. CAUTION! WHEN GASEOUS NOX FORM FROM A SPILL, SPECIALLY TRAINED PERSONNEL ARE NEEDED.  
 Neutralizing Agent: SODIUM BICARBONATE, SODA ASH  
 Waste Disposal Method: DISPOSE OF IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.  
 Precautions-Handling/Storing: STORE IN A COOL, DRY, WELL-VENTILATED PLACE. KEEP CONTAINER CLOSED WHEN NOT IN USE. KEEP AWAY FROM COMBUSTIBLE MATERIALS,

BASES, POWDERED METALS.

Other Precautions: NITROGEN OXIDES(NO\*X) ARE FORMED AROUND NITRIC ACID AND SHOULD BE VENTED. KEEP SODA ASH AND SAND AVAILABLE. ELECTRICAL FIXTURES SHOULD BE VAPOR-PROOF.

=====  
Control Measures  
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Respiratory Protection: USE SELF-CONTAINED OXYGEN OR CLEAN AIR SUPPLIED BREATHING APPARATUS.

Ventilation: LOCAL EXHAUST(FUME HOOD).

Protective Gloves: NEOPRENE

Eye Protection: SAFETY GOGGLES

Other Protective Equipment: NEOPRENE BODY SHIELD(FOR SPLASHING). PROVIDE A LOCAL EYE WASH STATION, SAFETY SHOWER, SODA ASH AND SAND.

Work Hygienic Practices: WASH HANDS. SEPERATE WORK CLOTHES FROM STREET CLOTHES. LAUNDER WORK CLOTHES BEFORE REUSE. KEEP FOOD OUT OF THE WORK AREA.

Suppl. Safety & Health Data: NITRIC ACID COMES IN VARYING CONCENTRATIONS FROM 55-100%; THIS MSDS IS SPECIFICALLY FOR CAS # 7697-37-2, WHICH IS ACS REAGENT GRADE, 69-71%. MSDS GENERATED FOR USE WITH DOD 4160.21-H(PAGE IV-37). MSDS SOURCE: MSDS/FTSS(CCINFO, 93-3).

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Transportation Data  
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Trans Data Review Date: 96100

DOT PSN Code: KFD

DOT Proper Shipping Name: NITRIC ACID

DOT Class: 8

DOT ID Number: UN2031

DOT Pack Group: II

DOT Label: CORROSIVE

IMO PSN Code: KPF

IMO Proper Shipping Name: NITRIC ACID

IMO Regulations Page Number: 8195

IMO UN Number: 2031

IMO UN Class: 8

IMO Subsidiary Risk Label: -

IATA PSN Code: RWA

IATA UN ID Number: 2031

IATA Proper Shipping Name: NITRIC ACID

IATA UN Class: 8

IATA Label: CORROSIVE

AFI PSN Code: RWF

AFI Symbols: 0

AFI Prop. Shipping Name: NITRIC ACID,

AFI Class: 8

AFI ID Number: UN2031

AFI Pack Group: II

AFI Basic Pac Ref: A12.11

MMAC Code: NR

Additional Trans Data: NONE

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Disposal Data  
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Label Data  
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Label Required: YES

Technical Review Date: 09APR96

MFR Label Number: UNKNOWN

Label Status: F

Common Name: NITRIC ACID

Signal Word: DANGER!

Acute Health Hazard-Severe: X

Contact Hazard-Severe: X



186 488

Fire Hazard-Slight: X  
Reactivity Hazard-Slight: X  
MAY LUNG IRRITATION OR DAMAGE. EYES: MAY CAUSE BURNS OR PERMANENT DAMAGE.  
SKIN: MAY CAUSE BURNS. INGEST: WILL BURN THE DIGESTIVE TRACT. STORE IN A COOL,  
DRY, WELL-VENTILATED PLACE. KEEP CONTAINER CLOSED WHEN NOT IN USE. KEEP AWAY  
FROM COMBUSTIBLE MATERIALS, BASES, POWDERED METALS. FIRST AID: SKIN: REMOVE  
CONTAMINATED CLOTHING; WASH WITH SOAP AND WATER. EYES: FLUSH WITH WATER FOR 15  
MINUTES. INHAL: REMOVE TO FRESH AIR. GIVE OXYGEN OR ARTIFICIAL RESPIRATION IF  
NEEDED. INGEST: DO NOT INDUCE VOMITING. GET PROMPT QUALIFIED MEDICAL  
ATTENTION. IF CONSCIOUS, GIVE 3 OR MORE GLASSES OF WATER.  
Protect Eye: Y  
Protect Skin: Y  
Protect Respiratory: Y  
Label Name: PROCURED BY: DEFENSE GENERAL SUPPLY CENTER  
Label Street: 8000 JEFFERSON DAVIS HIGHWAY  
Label City: RICHMOND  
Label State: VA  
Label Zip Code: 23297-5680  
Label Country: US  
Label Emergency Number: 804-279-4371

UNION OIL OF CALIFORNIA; UNION CHEMICAL DIV -- HEXANE (N-HEXANE) (AMSCO SOLV 1487)  
MATERIAL SAFETY DATA SHEET  
NSN: 8040008538913  
Manufacturer's CAGE: 77416  
Part No. Indicator: A  
Part Number/Trade Name: HEXANE (N-HEXANE) (AMSCO SOLV 1487)

## =====

## General Information

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Item Name: THINNER, ADHESIVE, RUBBER, NATURAL  
Company's Name: UNION OIL OF CALIFORNIA; UNION CHEMICAL DIV.  
Company's Street: 1345 NORTH MEACHAM ROAD  
Company's City: SCHAUMBURG  
Company's State: IL  
Company's Country: US  
Company's Zip Code: 60195  
Company's Emerg Ph #: 714-864-2310/ 800-424-9300  
Company's Info Ph #: 714-864-2310  
Distributor/Vendor # 1: CHEMICAL COMMODITIES AGENCY  
Distributor/Vendor # 1 Cage: 60777  
Record No. For Safety Entry: 006  
Tot Safety Entries This Stk#: 008  
Status: SM  
Date MSDS Prepared: 14MAR90  
Safety Data Review Date: 26APR91  
Supply Item Manager: GSA  
MSDS Preparer's Name: C. A. EISENHARD  
Preparer's Company: CHEMICAL COMMODITIES AGENCY, INC  
MSDS Serial Number: BKJQV  
Hazard Characteristic Code: N/  
Unit Of Issue: GL  
Unit Of Issue Container Qty: 1 GL CN  
Type Of Container: METAL

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## Ingredients/Identity Information

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Proprietary: NO  
Ingredient: HEXANE (N-HEXANE)  
Ingredient Sequence Number: 01  
NIOSH (RTECS) Number: MN9275000  
CAS Number: 110-54-3  
OSHA PEL: 500 PPM  
ACGIH TLV: 50 PPM; 9293  
Other Recommended Limit: NONE SPECIFIED

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Proprietary: NO  
Ingredient: CYCLOHEXANE  
Ingredient Sequence Number: 02  
Percent: 0.3-0.9  
NIOSH (RTECS) Number: GW9275000  
CAS Number: 110-82-7  
ACGIH TLV: 300 PPM  
Other Recommended Limit: NONE SPECIFIED

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Proprietary: NO  
Ingredient: OTHER HEXANE ISOMERS  
Ingredient Sequence Number: 03  
NIOSH (RTECS) Number: 1002929HI  
ACGIH TLV: 500 PPM  
Other Recommended Limit: NONE SPECIFIED

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## Physical/Chemical Characteristics

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186 490

Appearance And Odor: CLEAR, LITTLE IF ANY COLOR, ODOR-CHARACTERISTIC  
 Boiling Point: 150 TO 158F  
 Vapor Pressure (MM Hg/70 F): 140 @ 20C  
 Vapor Density (Air=1): > AIR  
 Specific Gravity: 0.674  
 Evaporation Rate And Ref: 8.10  
 Solubility In Water: NEGLIGIBLE  
 Percent Volatiles By Volume: 100

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Fire and Explosion Hazard Data

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Flash Point: -20F, -29C  
 Flash Point Method: TCC  
 Lower Explosive Limit: 1.0  
 Upper Explosive Limit: 8.0  
 Extinguishing Media: EXTINGUISH WITH DRY CHEMICAL, CO2 OR A UNIVERSAL TYPE FOAM.  
 Special Fire Fighting Proc: USE SCBA. WATER SPRAY MAY BE USEFUL IN MINIMIZING VAPORS & COOLING CONTAINERS EXPOSED TO HEAT & FLAME. AVOID SPREADING BURNING LIQUID W/WATER USED FOR COOLING.  
 Unusual Fire And Expl Hazrds: FLASHBACK ALONG VAPOR TRAIL MAY OCCUR. EXTREMELY FLAMMABLE & MAY IGNITE W/HEAT, SPARKS, FLAME OR STATIC ELEC. IF CONTAINER IS NOT PROPERLY COOLED IT MAY EXPLODE.

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Reactivity Data

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Stability: YES  
 Materials To Avoid: THIS PRODUCT IS INCOMPATIBLE WITH STRONG ACIDS OR BASES, OXIDIZING AGENTS AND SELECTED AMINES.  
 Hazardous Decomp Products: COMBUSTION MAY YIELD CARBON MONOXIDE AND/OR CARBON DIOXIDE.  
 Hazardous Poly Occur: NO

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Health Hazard Data

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Route Of Entry - Inhalation: YES  
 Route Of Entry - Skin: YES  
 Route Of Entry - Ingestion: YES  
 Health Haz Acute And Chronic: IRRITATION OF THE EYES, SKIN, NOSE & THROAT, DIGESTIVE SYS. EYE: DIRECT CONTACT MAY CAUSE STINGING, TEARING, REDNESS. SKIN: PROLONGED/REPEATED USE MAY CAUSE REDNESS, BURNING AND DRYING & PERIPHERAL NERVE DAMAGE. INGEST: NAUSEA. LUNG ASPIRATION.  
 Carcinogenicity - NTP: NO  
 Carcinogenicity - IARC: NO  
 Carcinogenicity - OSHA: NO  
 Signs/Symptoms Of Overexp: NERVOUS SYS DEPRESSION: HEADACHE, DROWSINESS, DIZZINESS, LOSS OF COORDINATION AND FATIGUE. ASPIRATION: MATERIAL ENTERS LUNGS WHEN SWALLOWING OR VOMITING & CAUSES LUNG INFLAMMATION & DAMAGE. REPORTS HAVE ASSOCIATED REPEATED/PROLONGED OCCUPATIONAL OVER-EXPOSURE TO SOLVENTS WITH PERMANENT BRAIN AND NERVOUS SYSTEM DAMAGE.  
 Med Cond Aggravated By Exp: PRE-EXISTING SKIN DISEASE IS MORE SUSCEPTIBLE TO EFFECTS OF THIS MATERIAL. LUNG DISORDERS MAY BE AGGRAVATED BY EXPOSURE. PRE-EXISTING HEART DISORDERS MAY BE MORE SUSCEPTIBLE TO IRREGULAR HEART BEATS.  
 HOLD EYELIDS APART & FLUSH EYE W/CLEAN WATER. GET MEDICAL AID. SKIN: REMOVE CONTAMINATED CLOTHING. WASH AREA THOROUGHLY W/MILD SOAP & WATER. GET MEDICAL AID. INHALE: MOVE VICTIM TO FRESH AIR. CPR OR OXYGEN AS NEEDED. IMMEDIATE MEDICAL AID. INGEST: DO NOT INDUCE VOMITING OR GIVE ANYTHING BY MOUTH BECAUSE THIS MATERIAL CAN ENTER LUNGS. GET MEDICAL AID.

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: STAY UPWIND & AWAY FROM SPILL. KEEP IGNITION SOURCES AWAY. VENTILATE AREA. A UNIVERSAL TYPE FOAM MAY BE USED TO SUPPRESS

186 491

VAPORS. KEEP OUT OF DRAINS, SEWERS OR WATERWAYS. USE INERT MATERIAL/ ABSORBENT TO DAM, CONTAIN, MOP UP. DO NOT FLUSH AREA W/WATER.  
 Waste Disposal Method: DISPOSE OF PRODUCT IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS. DISPOSE IN AN ENVIRONMENTALLY SAFE MANNER.  
 Precautions-Handling/Storing: KEEP CONTAINERS TIGHTLY CLOSED. KEEP COOL, DRY & AWAY FROM IGNITION SOURCES. USE W/ADEQUATE VENTING. DO NOT PRESSURIZE, CUT, WELD, BRAZE SOLDER, DRILL, \*  
 Other Precautions: \*GRIND OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS OR OTHER SOURCES IF IGNITION. \*EMPTY\* DRUMS SHOULD BE COMPLETELY DRAINED, PROPERLY BUNGED & PROMPTLY SHIPPED TO SUPPLIER OR DRUM RECONDITIONER. FOLLOW OSHA REGULATIONS, ANSI 149.1.

=====  
 Control Measures  
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Respiratory Protection: IF AIRBORNE CONCENTRATIONS EXCEED ESTABLISHED EXPOSURE LIMITS USE A SUPPLIED AIR RESPIRATOR. DO NOT USE A CHEMICAL CARTRIDGE RESPIRATOR.  
 Ventilation: ADEQUATE VENTILATION TO MAINTAIN AIRBORNE CONCENTRATIONS BELOW THE ESTABLISHED LIMITS.  
 Protective Gloves: IMPERMEABLE GLOVES TO PREVENT CONTACT.  
 Eye Protection: APPR'D EYE PROTECTION TO PREVENT CONTACT  
 Other Protective Equipment: SOURCE OF CLEAN WATER TO BE AVAILABLE IN WORK AREA FOR FLUSHING EYE/SKIN. IMPERVIOUS CLOTHING SHOULD BE WORN AS NEEDED.

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 Transportation Data  
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Trans Data Review Date: 91119  
 DOT PSN Code: HEX  
 DOT Proper Shipping Name: HEXANES  
 DOT Class: 3  
 DOT ID Number: UN1208  
 DOT Pack Group: II  
 DOT Label: FLAMMABLE LIQUID  
 IMO PSN Code: IBN  
 IMO Proper Shipping Name: NORMAL- HEXANE \*  
 IMO Regulations Page Number: SEE 3129  
 IMO UN Number: 1208  
 IMO UN Class: 3.1  
 IMO Subsidiary Risk Label: -  
 IATA PSN Code: NKG  
 IATA UN ID Number: 1208  
 IATA Proper Shipping Name: HEXANES  
 IATA UN Class: 3  
 IATA Label: FLAMMABLE LIQUID  
 AFI PSN Code: NKG  
 AFI Prop. Shipping Name: HEXANES  
 AFI Class: 3  
 AFI ID Number: UN1208  
 AFI Pack Group: II  
 AFI Basic Pac Ref: 7-7  
 MMAC Code: NK  
 N.O S. Shipping Name: HEXANE, FLAMMABLE LIQUID, UN 1208

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 Disposal Data  
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 Label Data  
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Label Required: YES  
 Label Status: G  
 Common Name: HEXANE (N-HEXANE) (AMSCO SOLV 1487)  
 Special Hazard Precautions: IRRITATION OF THE EYES, SKIN, NOSE & THROAT, DIGESTIVE SYS. EYE: DIRECT CONTACT MAY CAUSE STINGING, TEARING, REDNESS. SKIN: PROLONGED/REPEATED USE MAY CAUSE REDNESS, BURNING AND DRYING &

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PERIPHERAL NERVE DAMAGE. INGEST: NAUSEA. LUNG ASPIRATION. NERVOUS SYS  
DEPRESSION: HEADACHE, DROWSINESS, DIZZINESS, LOSS OF COORDINATION AND  
FATIGUE. ASPIRATION: MATERIAL ENTERS LUNGS WHEN SWALLOWING OR VOMITING &  
CAUSES LUNG INFLAMMATION & DAMAGE. REPORTS HAVE ASSOCIATED REPEATED/  
PROLONGED OCCUPATIONAL OVER-EXPOSURE TO SOLVENTS WITH PERMANENT BRAIN AND  
NERVOUS SYSTEM DAMAGE.

Label Name: UNION OIL OF CALIFORNIA; UNION CHEMICAL DIV.

Label Street: 1345 NORTH MEACHAM ROAD

Label City: SCHAUMBURG

Label State: IL

Label Zip Code: 60195

Label Country: US

Label Emergency Number: 714-864-2310/ 800-424-9300

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TERRA NITROGEN -- METHANOL - METHANOL,ACS  
MATERIAL SAFETY DATA SHEET  
NSN: 6810006878056  
Manufacturer's CAGE: TERRA  
Part No. Indicator: A  
Part Number/Trade Name: METHANOL

## General Information

Item Name: METHANOL,ACS  
Company's Name: TERRA NITROGEN CORPORATION  
Company's Street: WOODWARD COMPLEX, 1000 TERRA DR.  
Company's City: WOODWARD  
Company's State: OK  
Company's Country: US  
Company's Zip Code: 73801  
Company's Emerg Ph #: 800-424-9300(CHEMTREC)  
Company's Info Ph #: 405-256-8651(CHEMTREC)  
Distributor/Vendor # 1: HOME OIL CO (316-838-4663)  
Distributor/Vendor # 1 Cage: 0A9L8  
Record No. For Safety Entry: 002  
Tot Safety Entries This Stk#: 011  
Status: SE  
Date MSDS Prepared: 01DEC94  
Safety Data Review Date: 31MAR97  
Supply Item Manager: CX  
MSDS Serial Number: CDKPY  
Specification Number: O-C-265C  
Hazard Characteristic Code: F5  
Unit Of Issue: GL  
Unit Of Issue Container Qty: 1 GALLON  
Type Of Container: IP.3 CAN  
Net Unit Weight: 6.6 LBS

## Ingredients/Identity Information

Proprietary: NO  
Ingredient: METHYL ALCOHOL (METHANOL) (SARA 313) (CERCLA)  
Ingredient Sequence Number: 01  
Percent: 100  
NIOSH (RTECS) Number: PC1400000  
CAS Number: 67-56-1  
OSHA PEL: S, 200 PPM  
ACGIH TLV: S,200PPM/250STEL; 96  
Other Recommended Limit: NONE RECOMMENDED

## Physical/Chemical Characteristics

Appearance And Odor: LIQUID, COLORLESS OR CLEAR, FAINT ALCOHOLIC.  
Boiling Point: 148F,65C  
Melting Point: -144F,-98C  
Vapor Pressure (MM Hg/70 F): 127MM  
Vapor Density (Air=1): 1.1  
Specific Gravity: 0.791 @20C  
Decomposition Temperature: NP  
Evaporation Rate And Ref: >1,BUTYL ACETATE=1.0.  
Solubility In Water: 100%,COMPLETE.  
Percent Volatiles By Volume: NP  
pH: NP  
Corrosion Rate (IPY): NP

## Fire and Explosion Hazard Data

186 494

Flash Point: 51.8F,11.0C  
Flash Point Method: TCC  
Lower Explosive Limit: 6  
Upper Explosive Limit: 36  
Extinguishing Media: WATER SPRAY, DRY CHEMICAL, CO2, "ALCOHOL" FOAM.  
Special Fire Fighting Proc: EVACUATE AFFECTED AREA,STAY UPWIND,AVOID SMOKE/FUMES.USE WATER SPRAY TO COOL CNTNRS.IF SMOKE/FUMES CAN'T BE AVOIDED WEAR SELF-CONTAINED BREATHING APPARATUS.  
Unusual Fire And Expl Hazrds: FLAMM LIQ.FLAME INVISIBLE IN DAYLIGHT.  
METHANOL-WATER MIX WILL BURN UNLESS VERY DILUTE;MIXTURES W/25%<METHANOL CLASS I FLAMM LIQ.FOLLOW APPROPRIATE NFPA CODES.

## Reactivity Data

Stability: YES  
Cond To Avoid (Stability): KEEP AWAY FROM HEAT/SPARKS/FLAME.  
Materials To Avoid: DON'T STORE OR MIX W/STRONG OXIDIZERS,CHRONIC ANHYDRIDE,LEAD PERCHLORATE,OR PERCHLORIC ACID(RXS VIGOROUSLY).  
Hazardous Decomp Products: OCCURS FROM HEAT & REACTION W/ABOVE STATED MATERIALS.  
Hazardous Poly Occur: NO  
Conditions To Avoid (Poly): NOT APPLICABLE

## Health Hazard Data

LD50-LC50 Mixture: ORAL LD50:9100MG/KG IN RATS.  
Route Of Entry - Inhalation: YES  
Route Of Entry - Skin: YES  
Route Of Entry - Ingestion: NO  
Health Haz Acute And Chronic: LIQ/VAP CAN PENETRATE SKIN/MUCOUS MEMBRANE THEREFORE CONTROL OF INHAL MAY NOT BE SUFFICIENT TO TPEVNET EXCESSIVE DOSE. HARMFUL IF INHAL/ABSORBED THRU SKIN,CAUSES DMG TO LIVER/KIDNEY/NERVOUS SYST.CAUSES EYE/SKIN/NOSE/THROAT IRRIT.MAY BE FATAL/CAUSE BLINDNESS IF SWALLOWED.CAN'T BE MADE NON-POISONOUS.  
Carcinogenicity - NTP: NO  
Carcinogenicity - IARC: NO  
Carcinogenicity - OSHA: NO  
Explanation Carcinogenicity: PER MSDS:LISTED AS CARCINOGEN IN:IARC/NTP/ OSHA:NO.  
Signs/Symptoms Of Overexp: ACUTE:NON-SPEC DISCOMFT(NAU,WEAK),TEMP CNS DEPRESS W/ANETHETIC EFFECTS(DIZZ,HEAD,CONFUSION,INCOORD,UNCONSC),BLINDNESS. HIG EXPO:ABNOR LIVER/KIDNEY FUNCTION DETECTED BY LAB TEST,FATALITY FROM GROSS EXPO.INGEST(AS LITTLE AS 60ML)MAY CAUSE BLINDNESS,FATALITY.SKIN PERMEATION CAN OCCUR IN AMTS-PRODUCES SYS TOXICITY.  
Med Cond Aggravated By Exp: INDIVIDUALS W/PRE-EXISTING DISEASES OF RETINA OR LIVER MAY HAVE INCREASED SUSCEPTIBILITY TO TOXICITY OF EXCESSIVE EXPOSURES.  
Emergency/First Aid Proc: EYE:FLUSH IMMED/THOROUGHLY FOR 15MINS W/ WATER.IRRIT PERSISTS GET MED ATTN.SKIN:IMMED FLUSH W/PLENTY OF WATER FOR @LEAST 15MINS WHILE REMOVING CONTAMIN CLOTH/SHOES.CALL DR.INHAL:IMMED MOVE TO FRESH AIR.NOT BREATHING GIVE ART RESP;BREATHING DIFFICULT GIVE OXY.CALL DR.INGEST:AS LITTLE AS 60ML MAY CAUSE BLINDNESS/FATALITY.IMMED GIVE 2 GLASSES OF WATER.INDUCE VOMIT.CALL DR.NEVER GIVE ANYTHING (SUPPLEM)

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: KEEP UNNECESSARY PEOPLE AWAY.ISOLATE AREA. REVIEW FIRE/EXPLO/SAF PRECAUT BEF CLEANUP PROCEDURES.USE APPROPRIATE PPE. DIKE LG SPILLS.FLUSH AREA W/PLENTY OF WATER.DON'T FLUSH TO SEWER.COMPLY W/ REGS ON REPORTING RELEASES.CERCLA RQ:5000LBS.  
Neutralizing Agent NONE SPECIFIED BY MANUFACTURER.  
Waste Disposal Method: RQ:5000LBS/2270KG.TOXIC CHEM UNDER SEC 313 TITLE III OF SARA/40CFR372.CMPD HAS VERY LOW AQU TOXICITY.CLEANED UP MATL MAY BE RCRA HAZ WASTE.RCRA HAZ WASTE #:U154.COMPLY W/FRED/STATE/LOC REGS ON DISPO.

186 495

IF APPROVED INCINERATION,BIO-OXIDATION,(OTHER PREC)

Precautions-Handling/Storing: AVOID CONTACT W/EYE/SKIN/CLOTH.AVOID PROL/REP BREATH OF VAP.KEEP AWAY FROM HEAT/SPARKS/FLAME.KEEP CNTNR TIGHTLY CLOSD.STORE IN ADEQUATELY VENTI AREA.

Other Precautions: DON'T STORE/MIX W/STRONG OXIDIZERS,CHROMIC ANHYDRIDE, LEAD PERCHLORIC,PERCHLORIC ACID. DISPO:SUBSURFACE INJECTION,OR LIC DISPO CONTRACTOR MAY BE USED.

Control Measures

Respiratory Protection: WEAR AS APPROPRIATE:NIOSH/MSHA APPROVED RESPIRATORY PROTECTION.

Ventilation: GOOD GENERAL VENTILATION SHOULD BE PROVIDED TO KEEP VAPOR CONCEN BELOW THE EXPO LIMITS.

Protective Gloves: CHEMICAL RESISTANT GLOVES.

Eye Protection: CHEM SPLASH GOGG,SAF SPECTACLES,SIDESHIE

Other Protective Equipment: WEAR AS APPROP:COVERALL,FULL-LENGTH FC SHIED, HARD HAT W/BRIM,FLAME RESIST WORKCLOTH,CHEM RESIST CLOTH/FOOTWEAR/APRON.

Work Hygienic Practices: WASH THOROUGHLY AFT HNDLG.WASH CONTAMIN CLOTH/SHOES BEF REUSE.

Suppl. Safety & Health Data: 1ST AID:BY MOUTH IF UNCONSC.DR:PROVIDE STD METHANOL INGEST TREATMENT.ANTIDOTE:100ML OF 100-PROOF ETHYL ALCOHOL IN 2000ML WATER,GIVE 1.5ML/KG OF BODY WT OR 100ML FOR AVG ADULT.FOLLOW @2HR INTERVALS FOR 4DAYS,GIVE ORAL/INTRAVENOUSLY.ALLOW TIME FOR EXCRETION.BLOOD ETHANOL LEVELS=1.0-1.5MG/ML.

Transportation Data

Trans Data Review Date: 97090

DOT PSN Code: JEZ

DOT Symbol: I

DOT Proper Shipping Name: METHANOL, OR METHYL ALCOHOL

DOT Class: 3

DOT ID Number: UN1230

DOT Pack Group: II

DOT Label: FLAMMABLE LIQUID, POISON

IMO PSN Code: JPB

IMO Proper Shipping Name: METHANOL

IMO Regulations Page Number: 3251

IMO UN Number: 1230

IMO UN Class: 3.2

IMO Subsidiary Risk Label: TOXIC

IATA PSN Code: QHQ

IATA UN ID Number: 1230

IATA Proper Shipping Name: METHANOL

IATA UN Class: 3

IATA Subsidiary Risk Class: 6.1

IATA Label: FLAMMABLE LIQUID

AFI PSN Code: QHQ

AFI Prop. Shipping Name: METHANOL OR METHYL ALCOHOL

AFI Class: 3

AFI ID Number: UN1230

AFI Pack Group: II

AFI Label: 6.1

AFI Basic Pac Ref: A7.3

Additional Trans Data: PER MSDS:TRANSPO REQMTS:HAZ CLASS 3(FLAMM LIQ),RQ:5000LBS/2270KG,PROPER SHIPPING NAME:METHANOL,UN1230.

Disposal Data

Label Data

Label Required: YES



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Technical Review Date: 31MAR97

Label Status: F

Common Name: METHANOL

Chronic Hazard: YES

Signal Word: DANGER!

Acute Health Hazard-Severe: X

Contact Hazard-Slight: X

Fire Hazard-Severe: X

Reactivity Hazard-None: X

Special Hazard Precautions: LIQ/VAP PENETRATE SKIN/MUC MEMB. INHAL/ABSORBED THRU SKIN-HARMFUL, DMG TO LIVER/KIDNEY/NERV SYS, EYE/SKIN/NOSE/THROAT IRRIT, FATAL/BLINDNESS IF INGEST. CAN'T BE MADE NON-POIS. TARGET ORGANS: EYE/SKIN/LIVER/KIDNEY/CNS. 1ST AID: EYE: FLUSH IMMEDIATELY FOR 15MINS W/WATER. IRRIT PERSISTS GET MED ATTN. SKIN: IMMEDIATELY FLUSH W/PLENTY OF WATER FOR @LEAST 15MINS WHILE REMOVING CONTAMIN CLOTH/SHOES. CALL DR. INHAL: IMMEDIATELY MOVE TO FRESH AIR. NOT BREATHING GIVE ART RESP; BREATHING DIFFICULT GIVE OXY. CALL DR. INGEST: AS LITTLE AS 60ML MAY CAUSE BLINDNESS/FATALITY. IMMEDIATELY GIVE 2 GLASSES OF WATER. INDUCE VOMIT. CALL DR. NEVER GIVE ANYTHING BY MOUTH IF UNCONSC.

Protect Eye: Y

Protect Skin: Y

Protect Respiratory: Y

Label Name: TERRA NITROGEN CORPORATION

Label Street: WOODWARD COMPLEX, 1000 TERRA DR.

Label City: WOODWARD

Label State: OK

Label Zip Code: 73801

Label Country: US

Label Emergency Number: 800-424-9300 (CHEMTREC)

Year Procured: 1997

186 497

SCIENTIFIC GAS PRODUCTS SCOTT SPECIALITY GASE -- HYDROGEN - HYDROGEN  
MATERIAL SAFETY DATA SHEET  
NSN: 6830009652492  
Manufacturer's CAGE: 54262  
Part No. Indicator: A  
Part Number/Trade Name: HYDROGEN

## =====

## General Information

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Item Name: HYDROGEN  
Company's Name: SCIENTIFIC GAS PRODUCTS INC/SCOTT SPECIALITY GASES  
Company's Street: 2330 HAMILTON BLVD  
Company's City: SOUTH PLAINFIELD  
Company's State: NJ  
Company's Country: US  
Company's Zip Code: 07080  
Company's Emerg Ph #: 908-754-7700  
Company's Info Ph #: 908-754-7700  
Record No. For Safety Entry: 001  
Tot Safety Entries This Stk#: 002  
Status: SE  
Date MSDS Prepared: 16OCT96  
Safety Data Review Date: 06MAR97  
Supply Item Manager: CX  
MSDS Preparer's Name: UNKNOWN  
MSDS Serial Number: CDGHC  
Specification Number: BB-H-886C  
Spec Type, Grade, Class: GRADE A  
Hazard Characteristic Code: G2  
Unit Of Issue: CY  
Unit Of Issue Container Qty: 175 CU FT  
Type Of Container: CYLINDER  
Net Unit Weight: 0.92 LB  
NRC/State License Number: NOT RELEVANT

## =====

## Ingredients/Identity Information

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Proprietary: NO  
Ingredient: HYDROGEN  
Ingredient Sequence Number: 01  
Percent: >99  
NIOSH (RTECS) Number: MW8900000  
CAS Number: 1333-74-0  
OSHA PEL: NOT ESTABLISHED  
ACGIH TLV: NOT ESTABLISHED  
Other Recommended Limit: NONE RECOMMENDED

## =====

## Physical/Chemical Characteristics

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Appearance And Odor: COLORLESS, ODORLESS GAS  
Boiling Point: -422F, -252C  
Melting Point: -435F, -259C  
Vapor Pressure (MM Hg/70 F): GAS  
Vapor Density (Air=1): 0.07  
Specific Gravity: GAS  
Decomposition Temperature: UNKNOWN  
Evaporation Rate And Ref: GAS  
Solubility In Water: 1.82% @ 20C/68F  
Percent Volatiles By Volume: 100  
Viscosity: NOT RELEVANT  
Radioactivity: NOT RELEVANT  
Corrosion Rate (IPY): UNKNOWN  
Autoignition Temperature: 752F

186 498

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Fire and Explosion Hazard Data

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Flash Point: FLAMMABLE GAS  
 Lower Explosive Limit: 4%  
 Upper Explosive Limit: 75%  
 Extinguishing Media: HALOGENATED GAS, CARBON DIOXIDE, DRY CHEMICAL. WATER  
 SPRAY MAY BE USED TO KEEP FIRE EXPOSED CONTAINERS COOL.  
 Special Fire Fighting Proc: ONLY SAFE WAY TO EXTINGUISH FIRE IS TO STOP  
 FLOW OF GAS. IF FLOW CANNOT BE STOPPED, LET FIRE BURN ITSELF OUT WHILE  
 COOLING CONTAINERS WITH WATER. STAY UPWIND.  
 Unusual Fire And Expl Hazrds: EXTREMELY FLAMMABLE AND EXPLOSIVE. HYDROGEN  
 BURNS WITH AN ALMOST INVISIBLE FLAME. HYDROGEN IS VERY LIGHT AND RISES VERY  
 RAPIDLY IN AIR. INCREASE VENTILATION.

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Reactivity Data

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Stability: YES  
 Cond To Avoid (Stability): STORAGE IN POORLY VENTILATED AREA OR HEAT  
 SOURCE  
 Materials To Avoid: OXIDIZING AGENTS, SOME METALS, ALKALINE MATERIALS,  
 HALOGENS  
 Hazardous Decomp Products: NONE  
 Hazardous Poly Occur: NO  
 Conditions To Avoid (Poly): NOT RELEVANT

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Health Hazard Data

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LD50-LC50 Mixture: LD50 (ORAL RAT) IS NOT RELEVANT.  
 Route Of Entry - Inhalation: YES  
 Route Of Entry - Skin: NO  
 Route Of Entry - Ingestion: NO  
 Health Haz Acute And Chronic: TARGET ORGANS:LUNGS AND CNS. ACUTE- HYDROGEN  
 IS DEFINED AS A SIMPLE ASPHYXIAN. INHALATION OF HIGH CONCENTRATIONS OF  
 HYDROGEN MAY CAUSE DIZZINESS, HEADACHE, DEEPER BREATHING DUE TO AIR HUNGER,  
 POSSIBLE NAUSEA AND EVENTUAL UNCONSCIOUSNESS. EYES/SKIN/ORAL:NOT LIKELY TO  
 OCCUR. CHRONIC- NONE.  
 Carcinogenicity - NTP: NO  
 Carcinogenicity - IARC: NO  
 Carcinogenicity - OSHA: NO  
 Explanation Carcinogenicity: NONE  
 Signs/Symptoms Of Overexp: HYDROGEN IS INACTIVE BIOLOGICALLY AND  
 ESSENTIALLY NONTOXIC. IF THE EXCLUSION OF AN ADEQUATE SUPPLY OF OXYGEN TO  
 THE LUNGS OCCUR: HEADACHE, DIZZINESS, DROWSINESS, NAUSEA, VOMITING,  
 EXCITATION, EXCESS SALIVATION, UNCONSCIOUSNESS  
 Med Cond Aggravated By Exp: NONE  
 Emergency/First Aid Proc: PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL  
 CASES OF OVEREXPOSURE TO HYDROGEN. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH  
 SCBA. CONSCIOUS PERSONS SHOULD BE REMOVED TO AN UNCONTAMINATED AREA AND  
 INHALE FRESH AIR. QUICK REMOVAL FROM CONTAMINATED AREA IS MOST IMPORTANT.  
 UNCONSCIOUS PERSONS SHOULD BE MOVED TO AN UNCONTAMINATED AREA, GIVEN MOUTH-  
 TO-MOUTH RESUSCITATION & SUPPLEMENTAL OXYGEN.

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: WEAR PROTECTIVE EQUIPMENTS. VENTILATE AREA.  
 REMOVE ALL SOURCES OF IGNITION. STOP LEAK AND REMOVE LEAKING CONTAINERS TO  
 A SAFE OUTDOOR AREA OR TO EXHAUST HOOD IF YOU CAN DO WITHOUT RISK. ALLOW  
 GAS TO DISSIPATE.  
 Neutralizing Agent: NOT RELEVANT  
 Waste Disposal Method: ALLOW GAS TO DISCHARGE AT MODERATE RATE, IF  
 ALLOWED. RETURN IN THE SHIPPING CONTAINER PROPERLY LABELED, WITH ANY VALVE  
 OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE TO SUPPLIER.  
 Precautions-Handling/Storing: STORE CYLINDERS SECURED, IN UPRIGHT

186 499

POSITION. STORE AWAY FROM FLAMES, OXYGEN & OTHER OXIDIZERS. DO NOT STORE ABOVE 130F. PROTECT CYLINDERS FROM DAMAGE  
 Other Precautions: EXTREMELY FLAMMABLE. STORE AND USE WITH ADEQUATE VENTILATION. CLOSE VALVE WHEN NOT IN USE. NEVER WORK ON A PRESSURIZED SYSTEM. GAS CAN CAUSE RAPID SUFFOCATION. KEEP OUT OF REACH OF CHILDREN. POST NO SMOKING OR OPEN FLAMES SIGNS.

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 Control Measures  
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Respiratory Protection: IF AIRBORNE CONCENTRATIONS ARE HIGH, A NIOSH-APPROVED POSITIVE PRESSURE AIR SUPPLIED RESPIRATOR OR SELF-CONTAINED BREATHING APPARATUS MUST BE WORN.  
 Ventilation: MECHANICAL (GENERAL AND/OR LOCAL EXHAUST, EXPLOSION-PROOF) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV.  
 Protective Gloves: PLASTIC OR RUBBER RECOMMENDED  
 Eye Protection: SAFETY GLASSES OR GOGGLES RECOMMENDED  
 Other Protective Equipment: SAFETY SHOWER AND EYE WASH FOUNTAIN SHOULD BE LOCATED NEARBY. WEAR APPROPRIATE PROTECTIVE CLOTHING FOR RISK OF EXPOSURE.  
 Work Hygienic Practices: OBSERVE GOOD PERSONAL HYGIENE PRACTICES AND RECOMMENDED PROCEDURES.

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 Transportation Data  
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Trans Data Review Date: 97065  
 DOT PSN Code: HLR  
 DOT Proper Shipping Name: HYDROGEN, COMPRESSED  
 DOT Class: 2.1  
 DOT ID Number: UN1049  
 DOT Label: FLAMMABLE GAS  
 DOT/DoD Exemption Number: NOT RELEVANT  
 IMO PSN Code: IGH  
 IMO Proper Shipping Name: HYDROGEN, COMPRESSED  
 IMO Regulations Page Number: 2148  
 IMO UN Number: 1049  
 IMO UN Class: 2(2.1)  
 IMO Subsidiary Risk Label: -  
 IATA PSN Code: NSD  
 IATA UN ID Number: 1049  
 IATA Proper Shipping Name: HYDROGEN, COMPRESSED  
 IATA UN Class: 2.1  
 IATA Label: FLAMMABLE GAS  
 AFI PSN Code: NSD  
 AFI Symbols: 0  
 AFI Prop. Shipping Name: HYDROGEN, COMPRESSED  
 AFI Class: 2.1  
 AFI ID Number: UN1049  
 AFI Basic Pac Ref: A6.3,A6.7  
 Additional Trans Data: PROPER SHIPPING NAME AND UN ID NUMBER PER MSDS.

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 Disposal Data  
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 Label Data  
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Label Required: YES  
 Technical Review Date: 06MAR97  
 MFR Label Number: UNKNOWN  
 Label Status: F  
 Common Name: HYDROGEN  
 Chronic Hazard: NO  
 Signal Word: DANGER  
 Acute Health Hazard-Severe: X  
 Contact Hazard-None: X  
 Fire Hazard-Severe: X

186 500

Reactivity Hazard-None: X

Special Hazard Precautions: TARGET ORGANS:LUNGS & CNS. ACUTE- ASPHYXIAN.  
INHALATION OF HIGH CONCENTRATIONS OF HYDROGEN MAY CAUSE CNS EFFECTS,  
POSSIBLE NAUSEA & EVENTUAL UNCONSCIOUSNESS. EYES/SKIN/ORAL:NOT LIKELY TO  
OCCUR. CHRONIC- NONE. STORE AWAY FROM FLAMES & INCOMPATIBLES. STOP LEAK &  
REMOVE LEAKING CONTAINERS TO A SAFE OUTDOOR AREA/EXHAUST HOOD. ALLOW GAS TO  
DISSIPATE. FIRST AID- RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SCBA.  
CONSCIOUS PERSONS SHOULD BE REMOVED TO AN UNCONTAMINATED AREA. QUICK  
REMOVAL FROM CONTAMINATED AREA IS MOST IMPORTANT. UNCONSCIOUS PERSONS  
SHOULD BE MOVED TO AN UNCONTAMINATED AREA, GIVEN MOUTH-TO-MOUTH  
RESUSCITATION & SUPPLEMENTAL OXYGEN.

Label Name: SCIENTIFIC GAS PRODUCTS INC/SCOTT SPECIALITY  
GASES

Label Street: 2330 HAMILTON BLVD

Label City: SOUTH PLAINFIELD

Label State: NJ

Label Zip Code: 07080

Label Country: US

Label Emergency Number: 908-754-7700

Year Procured: 1997

186 501

BETZ LABORATORIES -- 625, REAGENT: PH BUFFER 10.0  
MATERIAL SAFETY DATA SHEET  
NSN: 681000N031557  
Manufacturer's CAGE: 24774  
Part No. Indicator: A  
Part Number/Trade Name: 625, REAGENT: PH BUFFER 10.0

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## General Information

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Company's Name: BETZ LABORATORIES INC  
Company's Street: 4636 SOMERTON RD  
Company's City: TREVOSE  
Company's State: PA  
Company's Country: US  
Company's Zip Code: 19047  
Company's Emerg Ph #: 800-877-1940  
Company's Info Ph #: 215-355-3300  
Record No. For Safety Entry: 001  
Tot Safety Entries This Stk#: 001  
Status: SMJ  
Date MSDS Prepared: 16FEB91  
Safety Data Review Date: 26JUL95  
MSDS Serial Number: BNSHF  
Hazard Characteristic Code: N1

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## =====

## Ingredients/Identity Information

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Proprietary: NO  
Ingredient: NON HAZARDOUS INGREDIENT  
Ingredient Sequence Number: 01  
NIOSH (RTECS) Number: 1000314NH  
OSHA PEL: NOT APPLICABLE  
ACGIH TLV: NOT APPLICABLE

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## =====

## Physical/Chemical Characteristics

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Appearance And Odor: COLORLESS LIQUID, NO ODOR.  
Specific Gravity: 1 (70F)  
Evaporation Rate And Ref: <1 (ETHER=1)  
Solubility In Water: 100%  
pH: 10

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## =====

## Fire and Explosion Hazard Data

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Extinguishing Media: DRY CHEMICAL, CARBON DIOXIDE, FOAM OR WATER.  
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA & FULL  
PROTECTIVE EQUIPMENT (FP N).  
Unusual Fire And Expl Hazrds: NONE SPECIFIED BY MANUFACTURER.

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## =====

## Reactivity Data

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Stability: YES  
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER  
Materials To Avoid: NONE SPECIFIED BY MANUFACTURER.  
Hazardous Decomp Products: THERMAL DECOMPOSITON (DESTRUCTIVE FIRES) YIELDS  
ELEMENTAL OXIDES.  
Hazardous Poly Occur: NO  
Conditions To Avoid (Poly): NOT RELEVANT

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## =====

## Health Hazard Data

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LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.  
Route Of Entry - Inhalation: YES

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Route Of Entry - Skin: NO  
Route Of Entry - Ingestion: YES  
Health Haz Acute And Chronic: ACUTE: SKIN/EYE - MODERATELY IRRITATING.  
INHAL - MISTS/AEROSOLS MAY CAUSE IRRITATION TO UPPER RESPIRATORY TRACT.  
BASED ON TEST RESULTS: MAY BE TOXIC IF ORALLY INGESTED. CHRONIC EFFECTS: NO  
EVIDENCE OF POTENTIAL CHRONIC EFFECTS.  
Carcinogenicity - NTP: NO  
Carcinogenicity - IARC: NO  
Carcinogenicity - OSHA: NO  
Explanation Carcinogenicity: NOT RELEVANT  
Signs/Symptoms Of Overexp: MAY CAUSE REDNESS OR ITCHING OF SKIN.  
Med Cond Aggravated By Exp: NOT KNOWN.  
Emergency/First Aid Proc: SKIN:REMOVE CONTAMD CLTHG. WASH EXPOS AREA W/LG  
QTY OF SOAP SOLN/H2O FOR 15 MIN. EYES:IMMED FLUSH W/H2O FOR A MINIMUM OF 15  
MIN. IMMED CONT MD FOR ADDL TREATMENT. INHAL:MOVE TO FRESH AIR. APPLY  
APPROP FIRST AID TREAT AS NEC. INGEST:GENERAL-DO NOT FEED ANYTHING BY MOUTH  
TO AN UNCON/CONVULSIVE VICTIM. SPECIFIC-DO NOT INDUCE VOMIT. IMMED CONT MD.  
DILUTE CONTENTS OF STOM USING 3-4 GLASSES MILK/H2O.

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#### Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: GENERAL-VENT AREA, USE SPECIFIED PROT EQUIP.  
CNTN/ABSORB ON ABSORBENT MATL. PLACE IN WASTE DISP CONTR. WASTE CHARACT OF  
ABSORBED MATL, OR ANY CONTAMD SOIL, SHLD BE DETERMINED I/A/W RCRA REGS.  
SPECIFIC-FLUSH AREA W/WATER. WET AREA MAY BE (SUPP DATA)  
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.  
Waste Disposal Method: GENERAL - WATER CONTAMD W/THIS REAGENT MAY BE SENT  
TO SANITARY SEWER, I/A/W ANY LOCAL AGREEMENT, A TREATMENT FACILITY OR  
DISCHARGED UNDER NFPDES PERMIT. REAGENT(AS IS)-INCINERATE OR BURY IN APPRVD  
LANDFILL. MUST BE I/A/W ALL FED/STATE/LOC REGS(FP N).  
Precautions-Handling/Storing: KEEP CONTAINER CLOSED WHEN NOT IN USE. DO  
NOT FREEZE. IF FROZEN, THAW AND MIX COMPLETELY PRIOR TO USE. ALKALINE - DO  
NOT MIX WITH ACIDIC MATERIAL.  
Other Precautions: USE PROTECTIVE EQUIPMENT IN ACCORDANCE WITH 29CFR  
SECTION 1910.132-134.

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#### Control Measures

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Respiratory Protection: USE NIOSH/MSHA APPRVD RESPIRATORS WITHIN USE  
LIMITATIONS OR ELSE USE NIOSH/MSHA APPRVD SUPPLIED AIR RESPIRATORS. IF  
VENTILATION IS INADEQ OR SIGNIFICANT REAGENT EXPOSURE IS LIKELY, USE NIOSH/  
MSHA APPRVD RESPIRATOR WITH DUST/MIST FILTERS.  
Ventilation: ADEQUATE VENTILATION TO MAINTAIN AIR CONTAMINANTS BELOW  
EXPOSURE LIMITS.  
Protective Gloves: RUBBER GLOVES.  
Eye Protection: CHEMICAL WORKERS GOGGLES (FP N).  
Other Protective Equipment: PROTECTIVE EQUIPMENT IN ACCORDANCE WITH 29 CFR  
1910.132-134.  
Work Hygienic Practices: WASH OFF AFTER EACH USE. REPLACE GLOVES AS  
NECESSARY.  
Suppl. Safety & Health Data: SPILL PROC: SLIPPERY. SPREAD SAND/GRIT.

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#### Transportation Data

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Trans Data Review Date: 92266  
DOT PSN Code: ZZZ  
DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION  
IMO PSN Code: ZZZ  
IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION  
IATA PSN Code: ZZZ  
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION  
AFI PSN Code: ZZZ  
AFI Prop. Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION  
Additional Trans Data: NOT REGULATED FOR TRANSPORTATION

186 502

186 50

## =====

## Disposal Data

## =====

## Label Data

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Label Required: YES  
Technical Review Date: 09JUN92  
Label Date: 09JUN92  
Label Status: G  
Common Name: 625, REAGENT: PH BUFFER 10.0  
Chronic Hazard: NO  
Signal Word: WARNING!  
Acute Health Hazard-Moderate: X  
Contact Hazard-Moderate: X  
Fire Hazard-Slight: X  
Reactivity Hazard-None: X  
Special Hazard Precautions: COMBUSTIBLE. AVOID ACIDS. ACUTE: MODERATELY IRRITATING TO EYES & SKIN. MIST/AEROSOLS MAY CAUSE IRRITATION TO UPPER RESPIRATORY TRACT. MAY BE TOXIC IF INGESTED. CHRONIC: NONE SPECIFIED BY MANUFACTURER.  
Protect Eye: Y  
Protect Skin: Y  
Protect Respiratory: Y  
Label Name: BETZ LABORATORIES INC  
Label Street: 4636 SOMERTON RD  
Label City: TREVOSE  
Label State: PA  
Label Zip Code: 19047  
Label Country: US  
Label Emergency Number: 800-877-1940



186 504

BETZ LABORATORIES -- 623, REAGENT: PH BUFFER 4.0  
MATERIAL SAFETY DATA SHEET  
NSN: 681000N031559  
Manufacturer's CAGE: 24774  
Part No. Indicator: A  
Part Number/Trade Name: 623, REAGENT: PH BUFFER 4.0

## =====

## General Information

=====

Company's Name: BETZ LABORATORIES INC  
Company's Street: 4636 SOMERTON RD  
Company's City: TREVOSE  
Company's State: PA  
Company's Country: US  
Company's Zip Code: 19047  
Company's Emerg Ph #: 800-877-1940  
Company's Info Ph #: 215-355-3300  
Record No. For Safety Entry: 001  
Tot Safety Entries This Stk#: 001  
Status: SMJ  
Date MSDS Prepared: 16FEB91  
Safety Data Review Date: 26JUL95  
MSDS Serial Number: BPLKY  
Hazard Characteristic Code: N1

=====

## =====

## Ingredients/Identity Information

=====

Proprietary: NO  
Ingredient: NONHAZARDOUS INGREDIENTS  
Ingredient Sequence Number: 01  
NIOSH (RTECS) Number: 1000314NH  
OSHA PEL: NOT APPLICABLE  
ACGIH TLV: NOT APPLICABLE

=====

## =====

## Physical/Chemical Characteristics

=====

Appearance And Odor: COLORLESS LIQUID, NO ODOR.  
Specific Gravity: 1@70F  
Evaporation Rate And Ref: <1(ETHER=1)  
Solubility In Water: 100%  
pH: 4

=====

## =====

## Fire and Explosion Hazard Data

=====

Extinguishing Media: DRY CHEMICAL, CO2, FOAM OR WATER.  
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA AND FULL  
PROTECTIVE EQUIPMENT (FP N).  
Unusual Fire And Expl Hazrds: NONE SPECIFIED BY MANUFACTURER.

=====

## =====

## Reactivity Data

=====

Stability: YES  
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.  
Materials To Avoid: NONE SPECIFIED BY MANUFACTURER.  
Hazardous Decomp Products: THERMAL DECOMPOSITION (DESTRUCTIVE FIRES)  
YIELDS ELEMENTAL OXIDES.  
Hazardous Poly Occur: NO  
Conditions To Avoid (Poly): NOT RELEVANT

=====

## =====

## Health Hazard Data

=====

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.  
Route Of Entry - Inhalation: YES

=====

186 505

Route Of Entry - Skin: NO  
Route Of Entry - Ingestion: YES  
Health Haz Acute And Chronic: ACUTE: SLIGHTLY IRRITATING TO SKIN/EYES.  
MISTS/AEROSOLS MAY CAUSE IRRITATION TO UPPER RESPIRATORY TRACT. CHRONIC: NO  
EVIDENCE OF POTENTIAL CHRONIC EFFECTS.  
Carcinogenicity - NTP: NO  
Carcinogenicity - IARC: NO  
Carcinogenicity - OSHA: NO  
Explanation Carcinogenicity: NOT RELEVANT  
Signs/Symptoms Of Overexp: INHALATION MAY CAUSE IRRITATION OF RESPIRATORY  
TRACT; SKIN CONTACT MAY CAUSE ITCHING AND/OR REDNESS.  
Med Cond Aggravated By Exp: NOT KNOWN.  
Emergency/First Aid Proc: SKIN: REMOVE CONTAMD CLTHG. WASH EXPOSED AREA  
W/LG QTY OF SOAP SOLN/H2O FOR 15 MIN. EYE: IMMED FLUSH W/H2O FOR @ LST 15  
MIN. IMMED CONT PHYS FOR ADDNL TRTMT. INHAL: REMOVE TO FRESH AIR. APPLY  
APPROP FIRST AID TRTMT AS NEC. INGEST: GEN-DO NOT FEED ANYTHING BY MOUTH TO  
AN UNCON/CONVULS VICTIM. SPEC-DILUTE CONTENTS OF STOM. INDUCE VOMIT BY ONE  
OF STD METH. IMMED CONTACT PHYS.

=====

Precautions for Safe Handling and Use

=====

Steps If Matl Released/Spill: GEN-VENT AREA, USE SPEC PROT EQUIP. CNTN &  
ABSORB ON ABSORB MATL. PLACE IN WASTE DISP CONTR. WASTE CHARACT OF ABSORBED  
MATL/ANY CONTAMD SOIL, SHOULD BE DETERMINED I/A/W RCRA REGS. SPEC-FLUSH  
AREA W/H2O. WET AREA MAY BE SLIPPERY. SPREAD SAND/GRIT.  
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.  
Waste Disposal Method: GEN-H2O CONTAM W/REAGENT MAY BE SENT TO A SANIT  
SEWER, I/A/W ANY LOC AGREEMENT, A TRTMT FACILITY/DISCHARGED UNDER NPDES  
PERMIT. REAGENT(AS IS)-INCIN OR BURY IN APPRVD LANDFILL. DISPOSE OF IN  
ACCORDANCE WITH FEDERAL, STATE AND LOCAL REGS (FP N).  
Precautions-Handling/Storing: NORMAL CHEMICAL HANDLING. KEEP CONTAINER  
CLOSED WHEN NOT IN USE. DO NOT FREEZE. IF FROZEN, THAW & MIX COMPLETELY  
PRIOR TO USE.  
Other Precautions: NONE SPECIFIED BY MANUFACTURER.

=====

Control Measures

=====

Respiratory Protection: USE PROT EQUIP I/A/W 29CFR 1910.132-134. USE  
NIOSH/MSHA APPRVD RESP W/IN USE LIMITATIONS OR ELSE USE NIOSH/MSHA APPRVD  
SUPPLIED AIR RESP. IF VENT IS INADEQ/SIGNIFICANT REAGENT EXPOS IS LIKELY,  
USE NIOSH/MSHA APPRVD DUST/MIST FILTERS.  
Ventilation: ADEQUATE VENTILATION.  
Protective Gloves: RUBBER GLOVES.  
Eye Protection: CHEMICAL WORKERS GOGGLES (FP N).  
Other Protective Equipment: NONE SPECIFIED BY MANUFACTURER.  
Work Hygienic Practices: WASH OFF AFTER EACH USE.  
Suppl. Safety & Health Data: NONE SPECIFIED BY MANUFACTURER.

=====

Transportation Data

=====

Trans Data Review Date: 92343  
DOT PSN Code: ZZZ  
DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION  
IMO PSN Code: ZZZ  
IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION  
IATA PSN Code: ZZZ  
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION  
AFI PSN Code: ZZZ  
AFI Prop. Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION  
Additional Trans Data: NOT REGULATED FOR TRANSPORTATION

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Disposal Data

=====

186 506

## Label Data

=====

Label Required: YES  
Technical Review Date: 05JUN92  
Label Date: 05JUN92  
Label Status: G  
Common Name: 623, REAGENT: PH BUFFER 4.0  
Chronic Hazard: NO  
Signal Word: CAUTION!  
Acute Health Hazard-Slight: X  
Contact Hazard-Slight: X  
Fire Hazard-None: X  
Reactivity Hazard-None: X  
SKIN/EYE: SLIGHTLY IRRITATING. INHAL: MISTS/AEROSOLS MAY CAUSE IRRITATION  
TO UPPER RESPIRATORY TRACT. CHRONIC: NONE LISTED BY MANUFACTURER.  
Protect Eye: Y  
Protect Skin: Y  
Protect Respiratory: Y  
Label Name: BETZ LABORATORIES INC  
Label Street: 4636 SOMERTON RD  
Label City: TREVOSE  
Label State: PA  
Label Zip Code: 19047  
Label Country: US  
Label Emergency Number: 800-877-1940

186 507

BETZ LABORATORIES -- PH BUFFER 7.0, 624  
MATERIAL SAFETY DATA SHEET  
NSN: 681000N076320  
Manufacturer's CAGE: 24774  
Part No. Indicator: A  
Part Number/Trade Name: PH BUFFER 7.0, 624

## =====

## General Information

=====

Company's Name: BETZ LABORATORIES INC  
Company's Street: 4636 SOMERTON RD  
Company's City: TREVOSE  
Company's State: PA  
Company's Country: US  
Company's Zip Code: 19053  
Company's Emerg Ph #: 800-877-1940  
Company's Info Ph #: 215-355-3300  
Record No. For Safety Entry: 001  
Tot Safety Entries This Stk#: 001  
Status: SMJ  
Date MSDS Prepared: 07SEP95  
Safety Data Review Date: 18MAR97  
MSDS Serial Number: CDKBG

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## =====

## Ingredients/Identity Information

=====

Proprietary: NO  
Ingredient: NON-HAZARDOUS INGREDIENTS  
Ingredient Sequence Number: 01  
NIOSH (RTECS) Number: 1000314NH  
OSHA PEL: N/K (FP N)  
ACGIH TLV: N/K (FP N)

-----

Proprietary: NO  
Ingredient: RESP PROT: SUPPLIED AIR-RESPS. IF AIR-PURIFYING RESP USE IS  
APPROP, USE A NIOSH APPRVD RESP WITH DUST/MIST FILTERS.  
Ingredient Sequence Number: 02  
NIOSH (RTECS) Number: 99999992Z  
OSHA PEL: NOT APPLICABLE  
ACGIH TLV: NOT APPLICABLE

=====

## =====

## Physical/Chemical Characteristics

=====

Appearance And Odor: COLORLESS LIQUID; NO ODOR.  
Specific Gravity: 1.00  
Evaporation Rate And Ref: <1.0 (ETHER=1)  
pH: 7.0

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## =====

## Fire and Explosion Hazard Data

=====

Flash Point: >200F, >93C  
Flash Point Method: SCC  
Extinguishing Media: DRY CHEMICAL, CARBON DIOXIDE, FOAM OR WATER.  
Special Fire Fighting Proc: USE NIOSH APPROVED SCBA AND FULL PROTECTIVE  
EQUIPMENT (FP N).  
Unusual Fire And Expl Hazrds: THERMAL DECOMPOSITION (DESTRUCTIVE FIRES)  
YIELDS ELEMENTAL OXIDES.

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## =====

## Reactivity Data

=====

Stability: YES  
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.  
Materials To Avoid: MAY REACT WITH STRONG OXIDES.

186 508

Hazardous Decomp Products: THERMAL DECOMPOSITION (DESTRUCTIVE FIRES)  
YIELDS ELEMENTAL OXIDES.  
Hazardous Poly Occur: NO  
Conditions To Avoid (Poly): NOT RELEVANT

## =====

## Health Hazard Data

=====

LD50-LC50 Mixture: LD50: (ORAL, RAT) >2,000 MG/KG  
Route Of Entry - Inhalation: YES  
Route Of Entry - Skin: YES  
Route Of Entry - Ingestion: YES  
Health Haz Acute And Chronic: ACUTE: SKIN: PRIMARY ROUTE OF EXPOSURE; MAY CAUSE SLIGHT IRRITATION TO THE SKIN. EYES: MAY CAUSE SLIGHT IRRITATION TO THE EYES. INHALATION: MISTS/AEROSOLS MAY CAUSE IRRITATION TO UPPER RESPIRATORY TRACT. INGESTION: MAY CAUSE SLIGHT GASTROINTESTINAL IRRITATION. TARGET ORGANS: NO EVIDENCE OF POTENTIAL CHRONIC EFFECTS.  
Carcinogenicity - NTP: NO  
Carcinogenicity - IARC: NO  
Carcinogenicity - OSHA: NO  
Explanation Carcinogenicity: NOT RELEVANT  
Signs/Symptoms Of Overexp: INHALATION MAY CAUSE IRRITATION OF THE RESPIRATORY TRACT. SKIN CONTACT MAY CAUSE ITCHING AND/OR REDNESS.  
Med Cond Aggravated By Exp: NOT KNOWN.  
Emergency/First Aid Proc: SKIN: REMOVE CONTAMD CLTHG. WASH EXPOSED AREA W/A LARGE QTY OF SOAP SOLUTION OR WATER FOR 15 MIN. EYES: IMMEDIATELY FLUSH EYES REMOVE VICTIM FROM CONTAMD AREA TO FRESH AIR. APPLY APPROP FIRST AID TREATMENT AS NEC. INGEST: DO NOT FEED ANYTHING BY MOUTH TO UNCON OR CONVULSIVE VICTIM. DO NOT INDUCE VOMIT. IMMEDIATE CONTACT MD. (SUPDAT)

=====

## Precautions for Safe Handling and Use

=====

Steps If Matl Released/Spill: VENTILATE AREA. USE SPECIFIED PROTECTIVE EQUIPMENT. CONTAIN AND ABSORB ON ABSORBENT MATERIAL. PLACE IN WASTE DISPOSAL CONTAINER. FLUSH AREA WITH WATER. WET AREA MAY BE SLIPPERY. SPREAD SAND/GRIT.  
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.  
Waste Disposal Method: WATER CONTAMD W/PROD MAY BE SENT TO SANITARY SEWER TREATMENT FACILITY I/A/W ANY LOCAL AGREEMENT, PERMITTED WASTE TREATMENT FACILITY OR DISCHARGED UNDER PERMIT. PROD AS IS-INCIN OR LAND DISPOSE IN APPRVD LANDFILL. IF THIS UNDILUTED PROD IS (SUPDAT)  
Precautions-Handling/Storing: NORMAL CHEMICAL HANDLING. KEEP CONTAINERS CLOSED WHEN NOT IN USE. DO NOT FREEZE. IF FROZEN, THAW AND MIX COMPLETELY PRIOR TO USE.  
Other Precautions: NONE SPECIFIED BY MANUFACTURER.

=====

## Control Measures

=====

Respiratory Protection: A RESP PROT PROGRAM THAT MEETS OSHA'S 29 CFR 1910.134 & ANSI Z88.2 REQS MUST BE FOLLOWED WHENEVER WORKPLACE CNDTNS WARRANT RESP'S USE. USE NIOSH APPRVD AIR-PURIFYING RESPS W/IN USE LIMITATIONS ASSOC W/EQUIP OR ELSE USE NIOSH APPRVD (ING 2)  
Ventilation: ADEQUATE VENTILATION.  
Protective Gloves: RUBBER GLOVES.  
Eye Protection: ANSI APPRVD CHEM WORKERS GOGGLES (FP N).  
Other Protective Equipment: ANSI APPROVED EYE WASH & DELUGE SHOWER (FP N). USE PROTECTIVE EQUIPMENT IN ACCORDANCE WITH 29 CFR 1910 SUBPART I.  
Work Hygienic Practices: WASH GLOVES OFF AFTER EACH USE. REPLACE AS NECESSARY.  
Suppl. Safety & Health Data: FIRST AID PROC: DILUTE CONTENTS OF STOMACH USING 3-4 GLASSES MILK/WATER. WASTE DISP METH: DISCARDED AS WASTE, RCRA HAZ WASTE # IS:N/A. PLEASE BE ADVISED, HOWEVER, THAT STATE & LOC REQS FOR WASTE DISP MAY BE MORE RESTRICTIVE/OTHERWISE DIFFERENT FROM FED REGS. CONSULT FED, STATE & LOC REGS REGARDING PROPER DISP OF MATL.

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186 509

## Transportation Data

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## Disposal Data

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## Label Data

=====

Label Required: YES  
Technical Review Date: 18MAR97  
Label Date: 30JAN97  
Label Status: G  
Common Name: PH BUFFER 7.0, 624  
Chronic Hazard: NO  
Signal Word: CAUTION!  
Acute Health Hazard-Slight: X  
Contact Hazard-Slight: X  
Fire Hazard-Slight: X  
Reactivity Hazard-None: X  
Special Hazard Precautions: COMBUSTIBLE. ACUTE: SKIN: MAY CAUSE SLIGHT IRRITATION TO THE SKIN WITH ITCHING AND/OR REDNESS. EYES: MAY CAUSE SLIGHT IRRITATION TO THE EYES. INHALATION: MISTS/AEROSOLS MAY CAUSE IRRITATION TO UPPER RESPIRATORY TRACT. INGESTION: MAY CAUSE SLIGHT GASTROINTESTINAL IRRITATION. CHRONIC: NONE LISTED BY MANUFACTURER.  
Protect Eye: Y  
Protect Skin: Y  
Protect Respiratory: Y  
Label Name: BETZ LABORATORIES INC  
Label Street: 4636 SOMERTON RD  
Label City: TREVOSE  
Label State: PA  
Label Zip Code: 19053  
Label Country: US  
Label Emergency Number: 800-877-1940

186 510

WATER CHEMISTRY -- STANDARD CONDUCTIVITY SOLUTION - STANDARD CONDUCTIVITY SOLUTION  
MATERIAL SAFETY DATA SHEET  
NSN: 6810009457682  
Manufacturer's CAGE: 66378  
Part No. Indicator: A  
Part Number/Trade Name: STANDARD CONDUCTIVITY SOLUTION

## =====

## General Information

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Item Name: STANDARD CONDUCTIVITY SOLUTION  
Company's Name: WATER CHEMISTRY, INC  
Company's Street: 3404 AERIAL WAY DR SW  
Company's P. O. Box: 4273  
Company's City: ROANOKE  
Company's State: VA  
Company's Country: US  
Company's Zip Code: 24015  
Company's Emerg Ph #: 540-989-0400  
Company's Info Ph #: 540-343-3618  
Record No. For Safety Entry: 008  
Tot Safety Entries This Stk#: 009  
Status: SM  
Date MSDS Prepared: 18JAN96  
Safety Data Review Date: 29SEP96  
Supply Item Manager: CX  
MSDS Serial Number: BZBCM  
Specification Number: DOD-R-23679  
Spec Type, Grade, Class: NONE  
Hazard Characteristic Code: N1  
Unit Of Issue: BT  
Unit Of Issue Container Qty: 250 ML  
Type Of Container: PPP-C-186  
Net Unit Weight: UNKNOWN  
NRC/State License Number: NONE  
Net Propellant Weight-Ammo: NONE

## =====

## Ingredients/Identity Information

=====

Proprietary: NO  
Ingredient: POTASSIUM CHLORIDE  
Ingredient Sequence Number: 01  
Percent: UNKNOWN  
NIOSH (RTECS) Number: TS8050000  
CAS Number: 7447-40-7  
OSHA PEL: NOT ESTABLISHED  
ACGIH TLV: NOT ESTABLISHED  
Other Recommended Limit: NONE RECOMMENDED

## =====

## Physical/Chemical Characteristics

=====

Appearance And Odor: CLEAR, ODORLESS LIQUID  
Boiling Point: NT  
Melting Point: NT  
Vapor Pressure (MM Hg/70 F): NT  
Vapor Density (Air=1): NT  
Specific Gravity: NT  
Decomposition Temperature: UNKNOWN  
Evaporation Rate And Ref: NT  
Solubility In Water: COMPLETE  
Viscosity: UNKNOWN  
Corrosion Rate (IPY): UNKNOWN

## =====

## Fire and Explosion Hazard Data

Flash Point: NA  
Lower Explosive Limit: NA  
Upper Explosive Limit: NA  
Extinguishing Media: USE ANY MEANS APPROPRIATE FOR SURROUNDING FIRE.  
Special Fire Fighting Proc: ALWAYS WEAR SELF-CONTAINED BREATHING APPARATUS OPERATED IN POSITIVE PRESSURE MODE WHEN FIGHTING FIRES TO WHICH CHEMICALS ARE EXPOSED.  
Unusual Fire And Expl Hazrds: NONE

#### Reactivity Data

Stability: YES  
Cond To Avoid (Stability): NONE  
Materials To Avoid: NONE  
Hazardous Decomp Products: OXIDES OF THE CONTAINED METAL & HALOGEN POSSIBLE, ALSO FREE OR IONIC HALOGEN.  
Hazardous Poly Occur: NO  
Conditions To Avoid (Poly): WILL NOT OCCUR. BROMINE TRIFLUORIDE, POTASSIUM PERMANGANATE PLUS SULFURIC ACID.

#### Health Hazard Data

LD50-LC50 Mixture: PRODUCT'S LD50 (ORAL RAT) WAS NOT STATED  
Route Of Entry - Inhalation: YES  
Route Of Entry - Skin: YES  
Route Of Entry - Ingestion: YES  
Health Haz Acute And Chronic: INHALATION OF HIGH CONCENTRATIONS OF DUST MAY CAUSE NASAL OR LUNG IRRITATION. INGESTION OF LARGE QUANTITIES CAN PRODUCE G/I IRRITATION & VOMITING. MAY PRODUCE WEAKNESS & CIRCULATORY PROBLEMS.  
Carcinogenicity - NTP: NO  
Carcinogenicity - IARC: NO  
Carcinogenicity - OSHA: NO  
Explanation Carcinogenicity: MFR GAVE THE ABOVE LISTING ON THE MSDS BUT NO OTHER COMMENTS ABOUT CARCINOGENICITY WERE RECORDED.  
Signs/Symptoms Of Overexp: CONTACT W/SKIN MAY CAUSE IRRITATION OR RASH, PARTICULARLY ON MOIST SKIN. CONTACT W/EYES MAY CAUSE REDNESS, TEARING, POSSIBLE ABRASION CAN OCCUR.  
Med Cond Aggravated By Exp: MFR GAVE NO INFORMATION OF MSDS.  
Emergency/First Aid Proc: IF IRRITATION PERSISTS OR IS SEVERE, GET MEDICAL ATTENTION. EYE: FLUSH W/WATER FOR 15 MIN. SKIN: FLUSH THOROUGHLY W/ SOAP & WATER. REMOVE CONTAMINATED CLOTHING. INHALED: REMOVE TO FRESH AIR. INGESTED: GIVE SEVERAL GLASSES OF WATER TO DILUTE. GET IMMEDIATE MEDICAL ATTENTION.

#### Precautions for Safe Handling and Use

Steps If Matl Released/Spill: SWEEP, SCOOP OR PICK UP SPILLED MATERIAL. COLLECTED WASTE MAY BE TRANSFERRED TO A CLOSED, PREFERRED METAL, CONTAINER.  
Neutralizing Agent: MFR GAVE NO INFORMATION OF MSDS.  
Waste Disposal Method: DISPOSE OF I/A/W FEDERAL, STATE & LOCAL ENVIRONMENTAL CONTROL REGULATIONS.  
Precautions-Handling/Storing: KEEP CONTAINER CLOSED WHEN NOT IN USE.  
Other Precautions: SAFETY SHOWER & EMERGENCY EYEWASH STATION SHOULD BE AVAILABLE IN IMMEDIATE VICINITY OF PRODUCT USE.

#### Control Measures

Respiratory Protection: NIOSH APPROVED  
Ventilation: USE MECHANICAL (GENERAL) VENTILATION & USE LOCAL EXHAUST.  
Protective Gloves: NITRILE  
Eye Protection: SAFETY GLASSES



Other Protective Equipment: MFR GAVE NO INFORMATION OF MSDS.  
Work Hygienic Practices: FOLLOW NORMAL HYGIENIC PRACTICES FOR HANDLING  
CHEMICALS.  
Suppl. Safety & Health Data: THIS MSDS OBTAINED BY DDRV & ENTERED AT THEIR  
REQUEST.

## =====

## Transportation Data

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Trans Data Review Date: 96273  
DOT PSN Code: ZZZ  
DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION  
IMO PSN Code: ZZZ  
IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION  
IATA PSN Code: ZZZ  
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION  
AFI PSN Code: ZZZ  
AFI Prop. Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION  
MMAC Code: NK  
N.O.S. Shipping Name: NONE  
Additional Trans Data: NONE

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## =====

## Disposal Data

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## =====

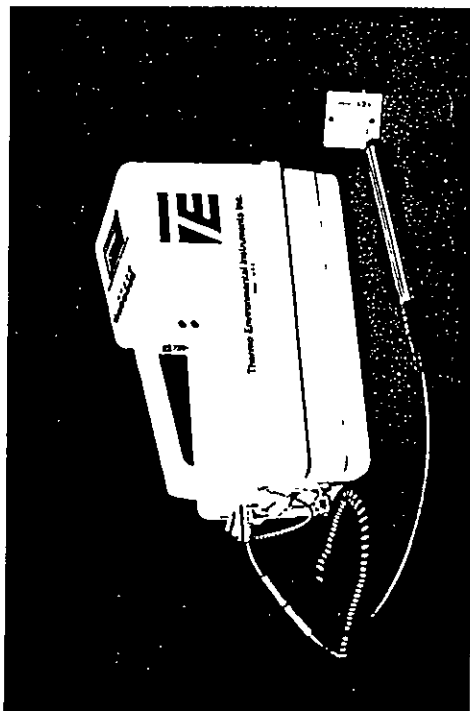
## Label Data

=====

Label Required: YES  
Technical Review Date: 29SEP96  
MFR Label Number: NONE  
Label Status: F  
Common Name: STANDARD CONDUCTIVITY SOLUTION  
Chronic Hazard: NO  
Signal Word: CAUTION!  
Acute Health Hazard-Slight: X  
Contact Hazard-Slight: X  
Fire Hazard-None: X  
Reactivity Hazard-None: X  
Special Hazard Precautions: \*\*TARGET-ORGANS:UNKNOWN\*\* INHALATION OF HIGH  
CONCENTRATIONS OF DUST MAY CAUSE NASAL OR LUNG IRRITATION. INGESTION OF  
LARGE QUANTITIES CAN PRODUCE G/I IRRITATION & VOMITING. MAY PRODUCE  
WEAKNESS & CIRCULATORY PROBLEMS. KEEP CONTAINER CLOSED WHEN NOT IN USE.  
Protect Eye: Y  
Protect Skin: Y  
Protect Respiratory: Y  
Label Name: WATER CHEMISTRY, INC  
Label Street: 3404 AERIAL WAY DR SW  
Label P.O. Box: 4273  
Label City: ROANOKE  
Label State: VA  
Label Zip Code: 24015  
Label Country: US  
Label Emergency Number: 540-989-0400

**Attachment 3**  
**Calibration Procedures for Air Monitoring Equipment**

## OVM Datalogger



### Calibration Check

#### Ready Instrument

1. Check to see what lamp is in the instrument
2. Power-up instrument by plugging in the power plug or the charger cable.

#### Start Up Instrument

1. Press "ON/OFF" key to ignite lamp and initiate sample pump. The words "LAMP OUT" will be displayed until lamp is ignited. Unit is then operational.

#### Setting Zero

1. Press "MODE/STORE" key.
2. Using "-/CRSR" key, scroll through. "LOG THIS VALUE"--"R/COMM"--"CONC METER"--"FREE SPACE"--"RESET TO CALIBRATE." Display should read "RF=1.00".
3. If RF needs to be changed, hold down "RESET" while pressing "-/CRSR" to select cursor position. Then use "+/INC" key to set response factor (RF) to "1.00". Release RESET key only when selection is made.
4. Using "-/CRSR" key, scroll to "LAMP". Verify LAMP setting. If the setting needs to be changed, press "RESET", press "+/INC" for 10 EV LAMP. Press "-/CRSR" for 11 EV LAMP. Press "RESET".

### Troubleshooting

When the analyzer is operating, dust or other foreign matter could be drawn into the probe, forming deposits on the surface of the UV lamp or in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, drifting, or show apparent moisture sensitivity. These deposits interfere with the ionization process and cause erroneous readings.

- If the battery is low, recharge the instrument.
- Drifting readings can mean that the lamp is dirty and needs to be cleaned.
- Humidity can cause false readings.
- High methane concentrations can result in false low readings.

5. Using "-/CRSR" key, scroll through "LAMP"--"ALM"--"AVERAGE"--"LOC. CODE MODE"--"AUTO LOGGING"--"CONC METER"--"FREE SPACE". Display should read "RESET TO CALIBRATE". Press "RESET" key.

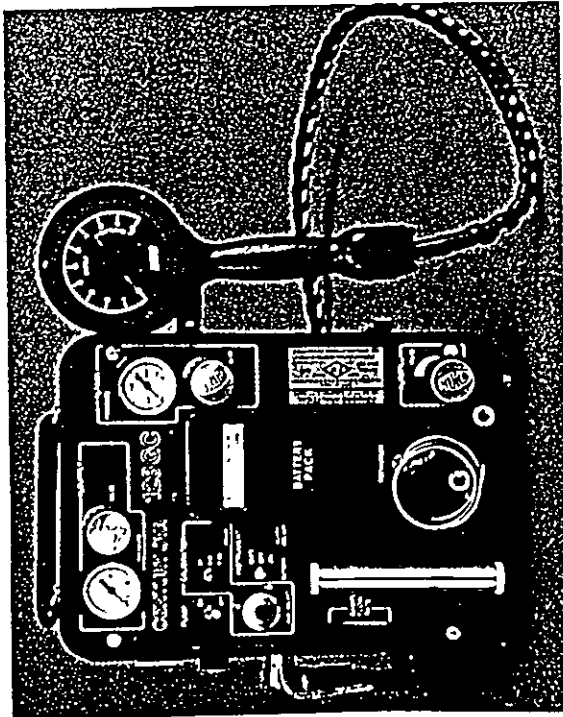
6. Press "-/CRSR" in response to "RESTORE BACKUP" prompt.

7. Press "RESET" key. Instrument will zero to ambient air. (Note: Zero gas or a zero filter may be used to set the unit to an absolute zero -- connect prior to pressing "RESET" key.)

### Calibration Check and Adjustment

1. Instrument should display "SPAN PPM = -- + TO CONTINUE".
2. Press "RESET" and "-/CRSR" keys simultaneously to select cursor position.
3. Press "RESET" and "+/INC" keys simultaneously to scroll through preset SPAN values. Set SPAN = 100, which corresponds to the 100 ppm isobutylene.
4. When span has been entered, press "+/INC" key to continue.
5. Connect span gas cylinder. Turn valve on. Press "RESET" key.
6. When finished calibrating, display will read "RESET TO CALIBRATE". Press "MODE/STORE" key. Display should read about 100 ppm. Turn valve off. Disconnect span gas cylinder.

## OVA 128



## Calibration Check

## Ready Instrument

- Check that the instrument is fully charged with hydrogen (99.999%)
- Check the battery condition by moving the INSTRUMENT switch to "BATT" – observe the needle response on the probe/readout assembly (Note. LIFT switches first, and then move)

## Start Up Instrument

1. Move the INSTRUMENT switch to the "ON" position.
2. Set the CALIBRATION SCALE switch to the "X1" position.
3. Use the CALIBRATION ADJUST knob to set the probe/readout assembly to read zero.
4. Move the PUMP switch to the "ON" position. Check the SAMPLE FLOW RATE – the normal range is 1.5 to 2.5 LPM (if less, do not use). Check that there are no sample line leaks by placing finger over the probe inlet – the pump should stop – and then release finger.
5. Open the H<sub>2</sub> TANK VALVE and then H<sub>2</sub> SUPPLY VALVE. Allow approximately 5 minutes for the hydrogen to purge the system.

6. Ignite the flame by depressing the red igniter button on the left side of the instrument. Do not hold down for more than 5 seconds.

7. Once ignited, set the CALIBRATION ADJUST knob to set the probe/readout assembly to read zero

## Calibration Check and Adjustment

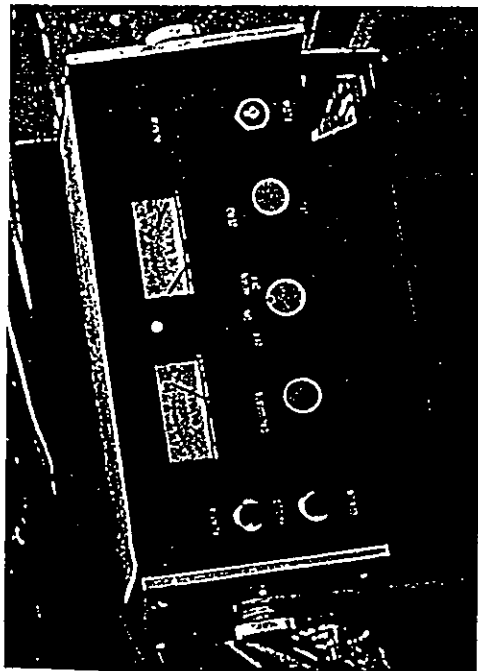
1. Set the CALIBRATION SCALE switch to the "X10" position.
2. Attach the 100 ppm methane cal-gas, using 1.5 LPM regulator with T-tubing to the instrument probe
3. Unlock the GAS SELECT knob, and adjust to 3.0 + 1.5 until probe/readout assembly reads 100 ppm. If the GAS SELECT setting is not within the acceptable range, do not use the instrument.
4. Detach the cal-gas. Before monitoring, set the probe/readout assembly arbitrarily to 1 ppm. If the needle goes flat (to zero), the flame may have been extinguished. The flame must be re-ignited before using.

## Troubleshooting

Troubleshooting Data			
Problem	Possible Procedure		Possible Solution
1 Low sample flow rate on flow indicator	a	Check Teflon tubing on valve assembly for kinks, etc	Straighten or replace Teflon tubing
	b	Check flow rate with valve in down position.	Check for over-restriction of charcoal filter
2 Hydrogen flame will not light	a	Check column connections on top of unit to make sure they are tight	Tighten fittings
	b	Check column for sharp bends or kinks (Hydrogen flows through this column at all times, and a sharp bend will compact packing too tightly for proper hydrogen flow.)	Replace column
	c	Check charcoal filter fittings to make sure they are tight.	Tighten fittings.
	d	Check hydrogen flow rate from the column.	Adjust hydrogen pressure to obtain 12 cm <sup>3</sup> /min flow rate
	e	Check that the inject and backflush valves are both completely in or out. A partially activated valve will block the hydrogen and air flow paths	Ensure both valves are either completely in or out.

Troubleshooting Data		
Problem	Possible Procedure	Possible Solution
	f If a new column was installed prior to identifying the problem, check for proper hydrogen flow rate through the column (should be approximately 12 cm/min)	Increase hydrogen pressure to obtain proper hydrogen flow rate, or if column is excessively restrictive, replace or repack the column
	g Allow time for hydrogen to reach ionization chamber	Wait several minutes before igniting flame
3 Ambient background reading in clean environment is too high	a Check for contamination in charcoal filter assembly. This can be detected if ambient reading increases when going into the chromatographic mode	Replace activated charcoal in charcoal filter assembly
	b Check for contamination in column	Replace or clean column
	c Check for contamination in column valve assembly	Remove valve stems and wipe with clean lint-free cloth. Heat valve assembly during operation to vaporize and remove contaminants
4 Flame-out when operating either valve	a Ensure valves are being operated with a quick, positive motion	Operate valve with a positive motion
	b Either hydrogen or air may be leaking around one or more of the valve quad rings. Assess by tests and O-ring inspection	Remove stems and lightly coat with silicone grease, only on contact surface of the O-ring. Wipe off excess (do not remove quad rings)
	c Damaged or worn quad rings causing leak	Replace quad rings and grease as above

## MSA Model 260, 261



### Calibration Check

#### Ready Instrument

- Check that the instrument was charged overnight.
- Turn the FUNCTION knob to manual "HORN OFF" position
- Verify that flow indicator is red

#### Zero Instrument

Zero the instrument within 30 seconds after turning instrument on. Set the readout to "00% LEL" by adjusting the ZERO LEL knob (Note: lift the knob first, then turn)

Set the readout to "20.8% OXY" by adjusting the CALIBRATE OXY knob.

#### Calibration Check and Adjustment

Connect cal-gas (0.75% pentane), with a 1.5 LPM regulator via direct tubing, to the sample port on the left side of the instrument.

Check that the readout is "50% LEL", + 5% LEL. If the "%LEL" is not within the acceptable range, do not use the instrument.

Check that the readout is "15% OXY", + 2% OXY. If the "%OXY" is not within the acceptable range, do not use the instrument.

Press the RESET button to clear alarm indicators.

### Troubleshooting

- Flow problems. Should flow continue when the inlet is shut, a leak in the flow system is indicated. Stop off the flow at the pump inlet, making sure the pump stalls. Work back the flow path toward the sample inlet until the leak is identified.
- If during calibration-check procedures the readings do not fall within acceptable ranges stated above, internal calibration must be performed by a qualified individual.
- The user **MUST** be familiar with the instrument's limitations (e.g., interfering compounds that foul the detector, low-battery operation, readout latch, etc.).

**Attachment 4**  
**CH2M HILL Jobsite Safety Inspection Checklist**

## STANDARD OF PRACTICE HS-18 - HEALTH AND SAFETY CHECKLIST

Date: 05/01/96

Note. The following jobsite safety inspection checklist is to be used only at locations where CH2M HILL controls the work. It is not to be used at locations where others control the work.

Project Name. \_\_\_\_\_ Project No : \_\_\_\_\_  
 Location: \_\_\_\_\_ Project Manager: \_\_\_\_\_  
 Inspector. \_\_\_\_\_ Date. \_\_\_\_\_

This checklist has been divided into two sections. The first section (I through XXVI) are applicable to all projects. The second section (XXVII through XXIX) addresses specific situations such as hazardous waste, construction activities, and office trailers. There may be some duplication between the first and second sections.

If an item is not applicable, the column titled "N/A" should be checked. If an item is applicable but the auditor does not observe it during the inspection, the "N/O" column should be checked. For each deficiency noted, a Health and Safety Audit Finding Form must be completed. The Corporate Health and Safety Director must be copied on the results of all audits.

Check "Yes" for Items Completed

Yes No N/A N/O

**HAZARDOUS WASTE****Certification and Training of CH2M HILL Personnel**

- |    |  |                          |                          |                          |                          |
|----|--|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. | Medical exam within last 12 months   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. | 40-hour initial training, 3 days supervised field activities, 8-hour annual        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. | First aid and CPR certification  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. | Quantitatively fit tested (preferred method per NIOSH Publication 87-Appendix B.3) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. | Attend pre-entry safety meeting  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. | Site Safety Coordinator with appropriate training                                  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**Certification and Training of Subcontractor Personnel**

- |    |   |                          |                          |                          |                          |
|----|---|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. | Medical exam within last 12 months  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. | 40-hour initial training, 3 days supervised field activities, 8-hour annual refresher | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. | First aid and CPR certification   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. | Quantitatively fit tested (preferred method per NIOSH Publication 87-(Appendix B.3)   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. | Attend pre-entry safety meeting   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



**Site Safety Documentation**

- |     |   |                          |                          |                          |                          |
|-----|---|--------------------------|--------------------------|--------------------------|--------------------------|
| 1.  | Site safety plan (SSP) prepared and approved  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2.  | SSP onsite  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3.  | All personnel onsite identified in SSP  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4.  | Documentation of safety briefing  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5.  | Hospital map posted   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6.  | Phone numbers posted  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7.  | Emergency vehicle identified  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8.  | Material Safety Data Sheets (MSDSs) onsite  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9.  | Work zones delineated<br>(How? _____)   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. | Wind direction flags in use   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. | Documentation of calibration of monitoring equipment in clean   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. | Monitoring conducted and recorded as specified in SSP<br>(Frequency? _____)                                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. | Monitoring for heat/cold stress   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. | Buddy system in use   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. | Decontamination procedures established as specified in SSP  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. | No eating, drinking, or smoking in exclusion and contamination  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. | Toilet facilities provided  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. | 533 Forms completed   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. | No contact lenses   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. | Work conducted during daylight hours only<br>Emergency equipment available as specified in SSP<br>(What?) _____ | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**Safety Briefing**

- |    |  |                          |                          |                          |                          |
|----|--|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. | All personnel attended (including new personnel) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|----|--|--------------------------|--------------------------|--------------------------|--------------------------|

2.	Documentation of meetings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	Chemical hazards and toxicology reviewed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	Physical hazards reviewed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	Biological hazards reviewed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.	Heat/cold stress information reviewed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.	Air monitoring requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.	Levels of protection reviewed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.	Work zones reviewed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.	Decontamination procedures reviewed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11.	Emergency response procedures reviewed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.	Site communications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Personal Protective Equipment (ppe)**

1.	Levels of protection being worn as specified in SSP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	All appropriate PPE available onsite	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	Hard hats being worn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	Appropriate hand protection being used (What?) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	Appropriate body protection being used (What?) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.	Appropriate eye protection being used (What?) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.	Appropriate ear protection being used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8.	Appropriate respirator protection being used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.	Respirators donned correctly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.	TLD badges being used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11.	If air purifying respirators (APRs) are being used, correct cartridges (Type?) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.	If self contained breathing apparatuses (SCBAs) are being used, is air being used	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- |     |  |                          |                          |                          |                          |
|-----|--|--------------------------|--------------------------|--------------------------|--------------------------|
| 13. | If SCBAs are being used, are cylinders stored correctly                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. | If personal protective equipment (PPE) is not onsite, prepared to halt | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. | Disposal methods in place for disposable PPE                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**Decontamination Procedures**

- |    |   |                          |                          |                          |                          |
|----|---|--------------------------|--------------------------|--------------------------|--------------------------|
| 1. | Decontamination procedure established as specified in the SSP | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. | Decontamination zone clearly defined                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. | PPE properly decontaminated<br>(How?) _____                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. | Sampling equipment properly decontaminated<br>(How?) _____    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. | Monitoring equipment properly decontaminated<br>(How?) _____  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. | Heavy equipment properly decontaminated<br>(How?) _____       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. | Samples properly decontaminated<br>(How?) _____               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. | Decontamination fluids appropriately disposed of              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |